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Paper No. 1. Session 1973 - 74

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LLOYD'S REGISTER OF SHIPPING'S RELATIONS WITH IMCO AND IACS

One can today, without much fear of contradiction, assert that, to find anyone actively engaged in shipping without some knowledge of the abbreviation IMCO, is akin to looking for the proverbial "needle in a haystack". However, possibly due to its comparatively shorter existence, not so many in the industry are so well acquainted with the organisation denoted by the letters IACS.

The Organisation IMCO and IACS are connected, the technical activities within each generally overlap, and Lloyd's Register of Shipping enjoys certain relations with both. It is thought that, before delving too deeply into these connections and relations, it may be to advantage to describe the origins, administrative structure and activities of each body so that their ultimate purposes can be illustrated and the extent of the Society's relations appreciated.

IMCO—Inter-Governmental Maritime Consultative Organisation

This specialised agency of the United Nations was established by a Convention at Geneva in 1948, and came into force ten years later when 21 states became parties to the Convention. IMCO now has a total membership of some 77 countries (March 1973).

The IMCO Convention clearly stated that the functions of the Organisation shall be consultative and advisory. It provided the machinery for co-operation and for the exchange of information between governments on technical matters related to the adoption of the highest practicable standards for ensuring maritime safety and efficiency of navigation. It also provided the means for dealing with unfair restrictive practices by shipping concerns.

The principal organs within the structure of the Organisation are the Assembly, the Council, the Maritime Safety Committee and various Sub-Committees which function under the auspices of the Maritime Safety Committee. There are other divisions such as legal, administration, technical co-operation, etc., which are normally outwith the interest of the Society.

Fig. I shows diagrammatically the arrangement of the various principal organs of IMCO and Fig. II the internal administrative structure of this Organisation.

The Maritime Safety Committee (MSC) deals with most technical subjects and is, through the Council, required to submit to the Assembly proposals made by Members for safety regulations, or for amendments to existing safety regulations together with its comments and recommendations thereon. This Committee is also required to report, in a similar manner, on its work since the previous regular session of the Assembly.

The Assembly, at which all Member States are represented, holds its regular session once every two years, whereas, the Council and MSC, both of which are elected by the Assembly, normally meet twice a year.

In addition to the technical matters dealt with by the MSC, and those subjects considered by the Legal Committee, for presentation to the Assembly; IMCO or its Secretary-General acts as depository for a series of international agreements in the field of maritime traffic and maritime law. The Conventions so involved are as listed in Fig. III.

The Headquarters of IMCO are established in London, and the meeting of the Assembly last took place there in October 1971. To that time some 258 Resolutions had been adopted with far-reaching effects on such matters as the tonnage measurement of ships, grain cargoes, stability, pollution, chemical tankers, navigation, etc.

IMCO by comparison with other United Nations Agencies is small, its budget being of the order of $2 000 000 per annum and the staff employed under 150 persons. Nevertheless, the IMCO Secretariat issues some 10 000 000 sheets annually in the form of documents on various matters to 77 member countries, together with approximately 25 bodies in consultative status, and other bodies where a liaison exists. It only requires simple arithmetic to realise that there is quite a substantial volume of reading matter originating from IMCO Headquarters in London.

At its inception, IMCO was a purely inter-governmental organisation but soon the need for wider consultation was realised, as indicated, by the Assembly approving in May 1961 "Rules governing relationship with non-governmental organisations". These Rules permitted, subject to the approval of the Assembly, consultative status being granted to any non-governmental international organisation, which was able to make a substantial contribution to the work of IMCO. In this connection the Council had to be satisfied that the activities of such non-governmental international organisations accorded with the IMCO Convention and that their objectives and functions were in full harmony with the spirit, functions and principles of IMCO.

IACS—International Association of Classification Societies

In the decade following the ratification of the IMCO Convention there is little evidence of any enthusiastic attempts to institute close relations between the new agency of the U.N. and the classification societies. In fact, the early years of IMCO appear to have been regarded, in shipping circles, with some misgiving and apprehension.

It is considered that the main factors which caused a change of attitude and led to the formation of IACS were, perhaps, the serious concern in the late 60's over the manner in which IMCO activities were beginning to encroach on matters of concern to classification, the establishment of an IMCO Sub-Committee on Ship Design and Equipment, and the possibility for consultative status being granted by IMCO to a non-governmental international organisation composed of the major classification societies.

The major classification societies had, in fact, already been meeting informally over some 30 years but, at Hamburg, in 1968 the adoption of a Charter formalised the creation of the International Association of Classification Societies or, in its abbreviated form, IACS.

The Charter of the Association stated that the purpose of IACS was to promote by co-operation and consultation the aims which its Members hold in common and provide for consultation and co-operation with other national and international organisations.

IACS was, in 1970, granted consultative status at the Inter-Governmental Maritime Consultative Organisation and its Observers now attend, as considered appropriate, meetings of the Assembly and the various IMCO Committees. Thus it is able to play some part in the shaping of recommendations and conventions dealt with by IMCO.

The Classification Societies constituting the Association and the Structure of this Organisation are as shown in Fig. IV.

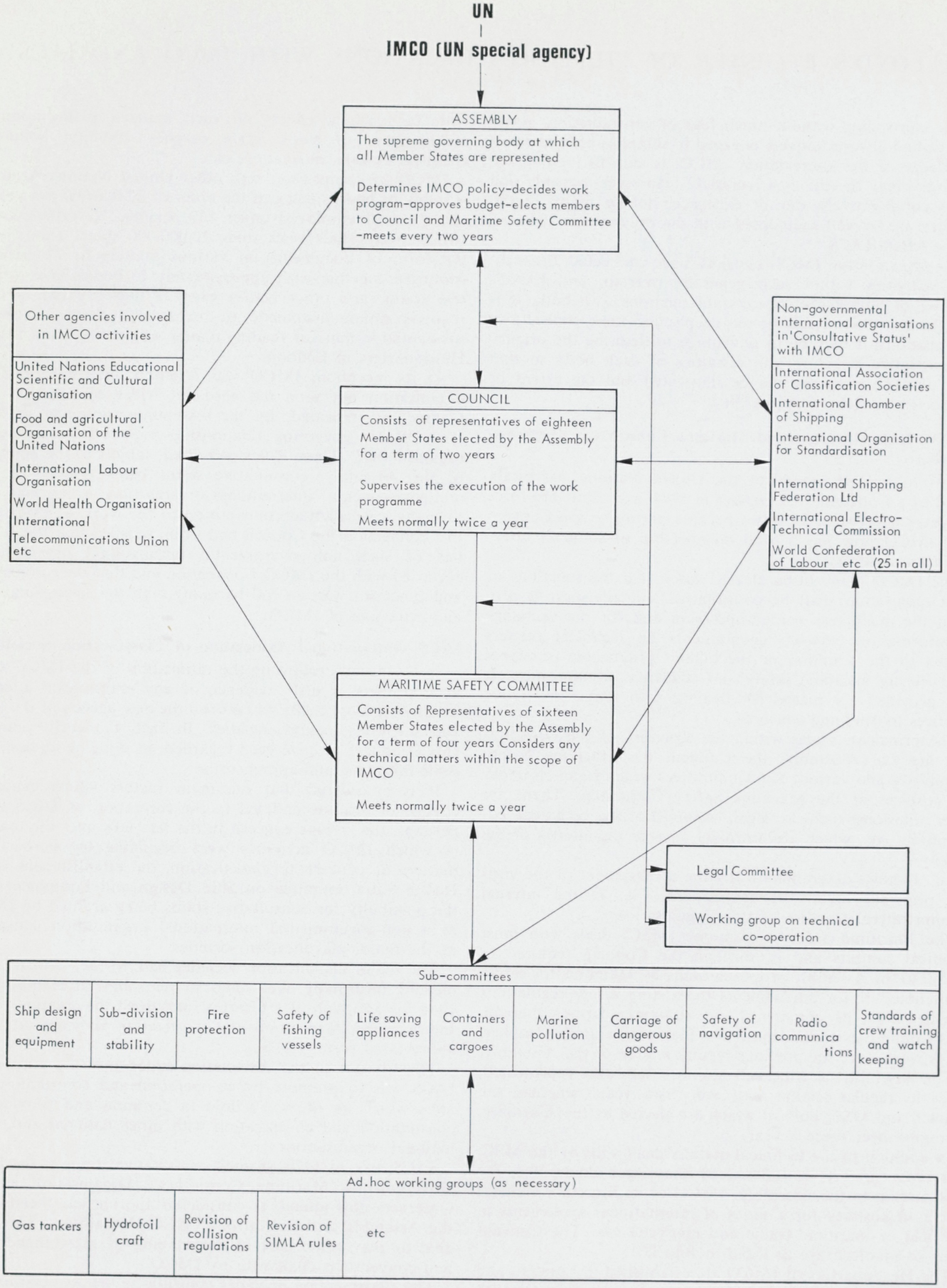
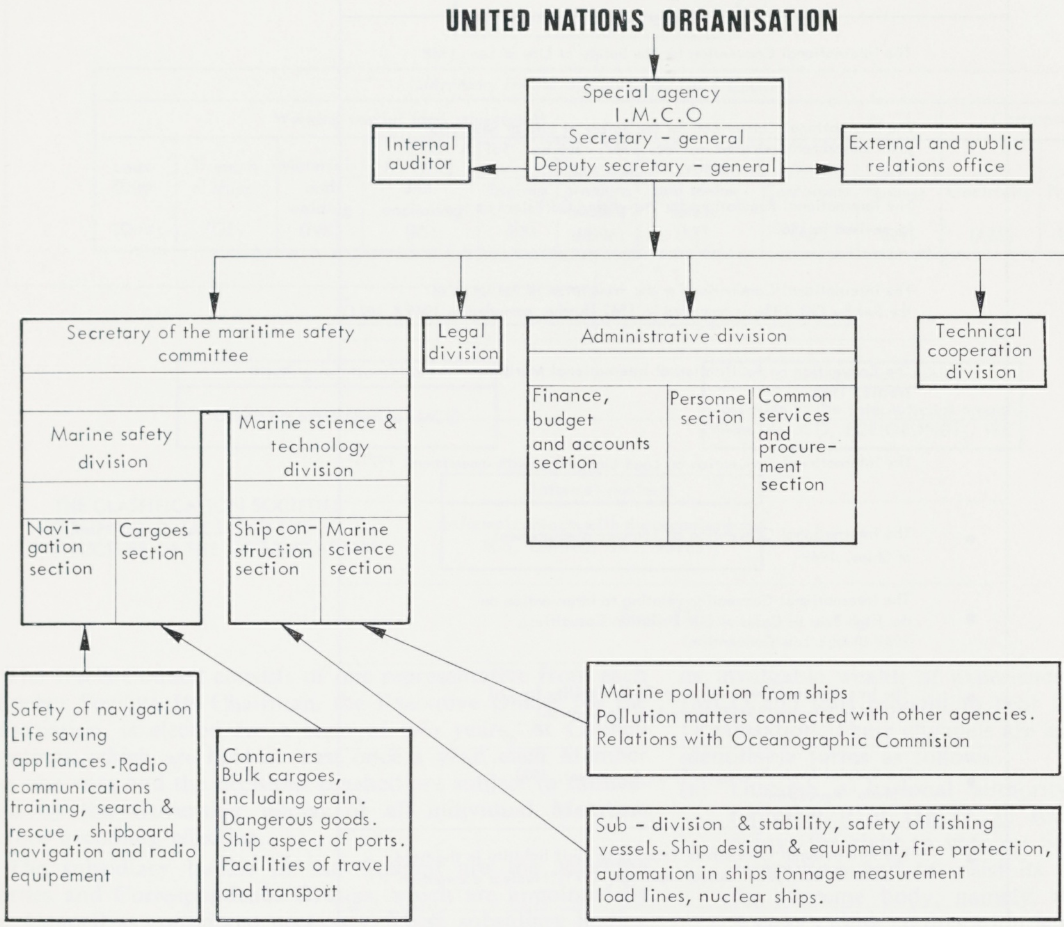

UN
IMCO (UN special agency)
ASSEMBLY
The supreme governing body at which all Member States are represented
Determines IMCO policy-decides work program-approves budget-elects members to Council and Maritime Safety Committee -meets every two years
Other agencies involved in IMCO activities
United Nations Educational Scientific and Cultural Organisation
Food and agricultural Organisation of the United Nations
International Labour Organisation
World Health Organisation
International Telecommunications Union
etc
COUNCIL
Consists of representatives of eighteen Member States elected by the Assembly for a term of two years
Supervises the execution of the work programme
Meets normally twice a year
Non-governmental international organisations in 'Consultative Status' with IMCO
International Association of Classification Societies
International Chamber of Shipping
International Organisation for Standardisation
International Shipping Federation Ltd
International Electro-Technical Commission
World Confederation of Labour etc (25 in all)
MARITIME SAFETY COMMITTEE
Consists of Representatives of sixteen Member States elected by the Assembly for a term of four years Considers any technical matters within the scope of IMCO
Meets normally twice a year
Legal Committee
Working group on technical co-operation
Sub-committees
Ship design and equipment
Sub-division and stability
Fire protection
Safety of fishing vessels
Life saving appliances
Containers and cargoes
Marine pollution
Carriage of dangerous goods
Safety of navigation
Radio communications
Standards of crew training and watch keeping
Ad.hoc working groups (as necessary)
Gas tankers
Hydrofoil craft
Revision of collision regulations
Revision of SIMLA rules
etc

FIG. I



THE ADMINISTATIVE ORGANISATION OF I.M.C.O

Fig. II

INTERGOVERNMENTAL MARITIME CONSULTATIVE ORGANISATION (IMCO)

LIST OF CONVENTIONS	
	The Convention on the Inter- Governmental Maritime Consultative Organisation, 1948
	The International Convention for the Safety of Life at Sea, 1948
	The International Convention for the Safety of Life at Sea, 1960 (with amendments adopted in 1966, 1967, 1968 and 1969 & 1971)*
	The International Regulations for Preventing Collisions at Sea (as revised in 1960)
	The International Convention for the Prevention of Pollution of the Sea by Oil, 1954 as amended in 1962 (further amended in 1969 & 1971)*
	The Convention on Facilitation of International Maritime Traffic, 1965
	The International Convention on Load Lines, 1966 (with amendments 1971)*
•	The International Convention on Tonnage Measurement of Ships, 1969
•	The International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 (Public Law Convention)
•	The International Convention on Civil Liability for Oil Pollution Damage, 1969(Private Law Convention)
•	The Special Trade Passengers Ships Agreement, 1971 ("Simla" Agreement)
•	The International Convention relating to civil liability in the field of maritime carrige of nuclear material, 1971("Nuclear convention")
•	The International convention on the establishment of an international fund for compensation for oil pollution damage, 1971 ("Fund convention)
•	The Convention on the International Regulations for Preventing Collisions at Sea, 1972
•	The International Convention for Safe Containers 1972

• Not yet in force
* Amendments not yet in force

(See also annex 2 for further details)

FIG. III

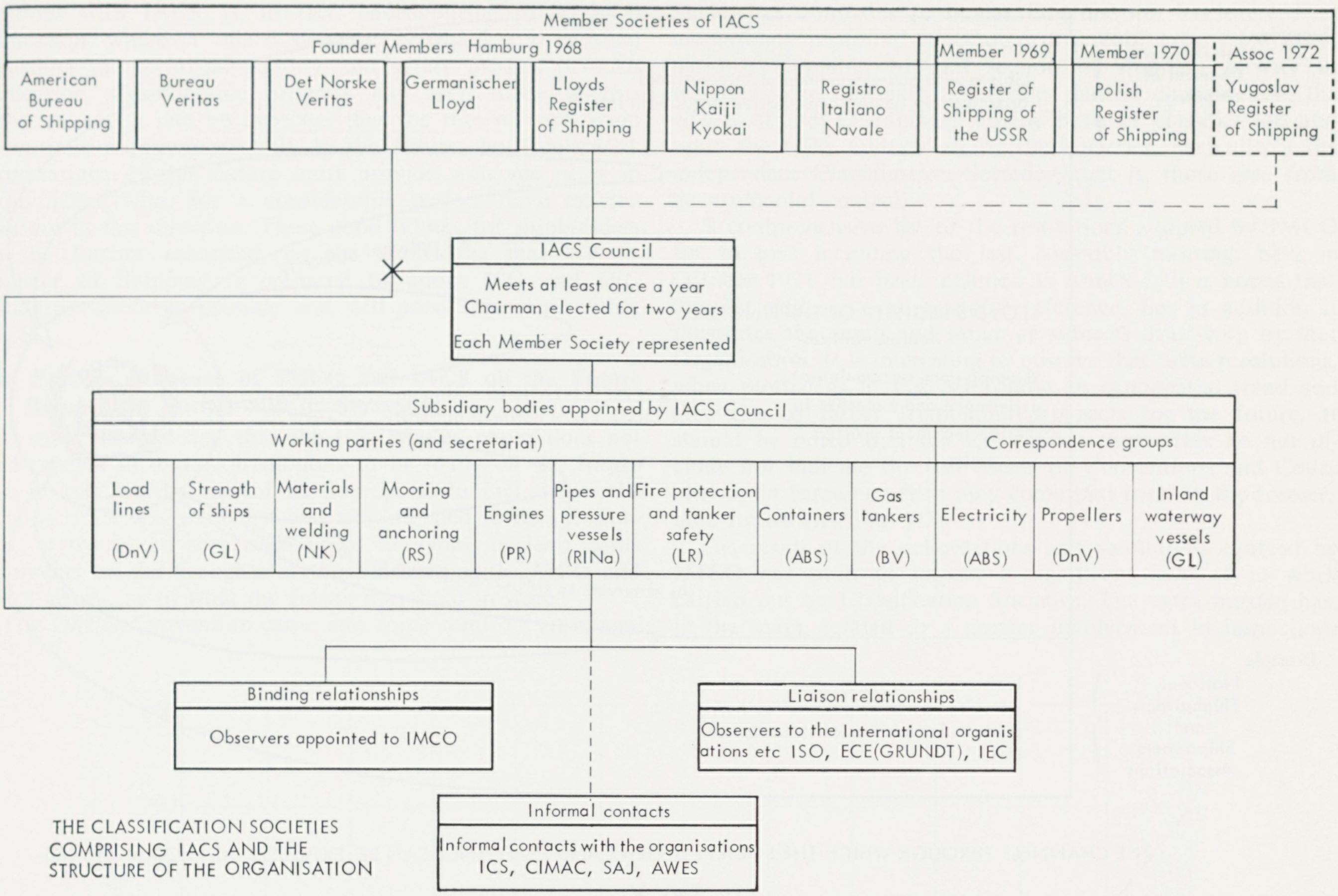


FIG. IV

The IACS Council consists of one representative from each Member Society. Its Chairman, the Executive Officer for the Association, is elected for a term of two years. At Council meetings, which are held at least once a year, each Member has one vote and the decisions reached are subject to ratification by the Governing Bodies of all individual Members before becoming effective.

The subsidiary bodies to the Council are the Working Parties and Correspondence Groups, which are appointed by the Council as considered necessary. These subsidiary bodies, as will be seen, deal with specific technical subjects and report annually to the Council on the progress of their assigned tasks.

At this stage attention can be turned to the Society's relations with both IMCO and IACS.

Lloyd's Register of Shipping's relations with IMCO

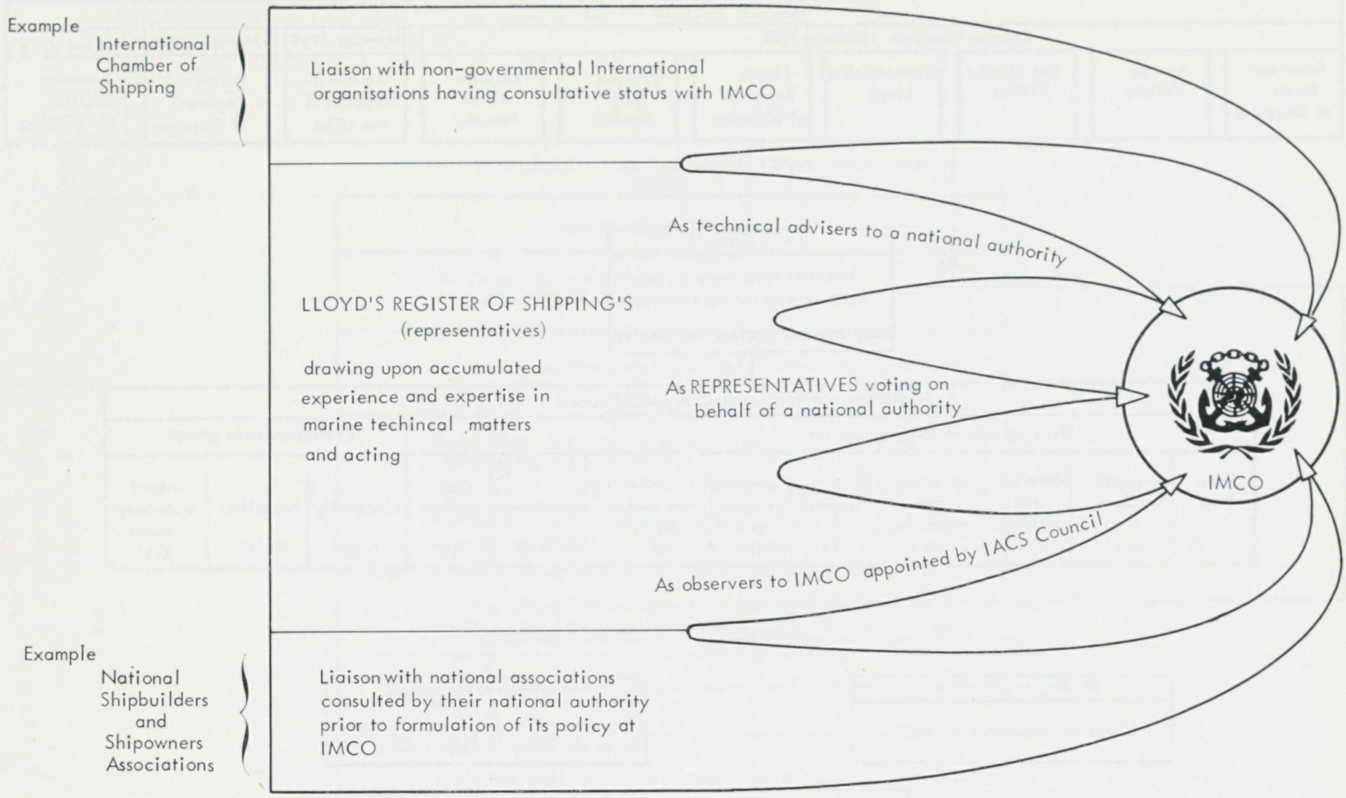
It is a regrettable fact that the Society, even as the world's oldest and largest classification authority, with its many and imposing international activities is, under the terms of the IMCO Convention, precluded from direct involvement and voting rights in the promulgation of the recommendations of that Organisation.

Some small consolation can, however, be gained from the realisation that all other classification societies are, in theory, faced with the same situation. Lloyd's Register of Shipping does at least, have access to certain channels through which its invaluable wealth of experience can be communicated to IMCO and thus brought to bear in the deliberations of that Organisation. These channels are as shown in Fig. V and take identifiable forms as follows.

(a) Through a national authority inviting the Society to represent it at IMCO. In such cases the Society often enjoys the right to vote on behalf of that State on sub-committees and to assist its delegations at meetings of the supreme body, namely, the IMCO Assembly. The Society's close co-operation with the Liberian Authorities is an example of this means.

(b) Through the Society's representatives being requested to act as technical advisers to national delegations. It can be mentioned that such requests have been received on many occasions from the Government of the United Kingdom through its Department of Trade and Industry. These requests generally involve meetings between the delegates and the representatives of the Society, for technical exchanges prior to the meetings at IMCO, and the Society's representatives usually accompany the delegates to the IMCO meetings.

(c) Through the Society's representatives attending IMCO as "observers" appointed by the Council of IACS. In this case an IACS observer can express views previously agreed to by the Association but does not enjoy the right to vote since attendance is consequent upon the recognition of the consultative status of IACS.



THE CHANNELS THROUGH WHICH THE SOCIETY'S VIEWS AND EXPERIENCE CAN BE EXPRESSED AT IMCO MEETINGS

Fig. V

It is stressed that the Society is always pleased to entertain requests from national administrations in respect of (a) and (b).

Other indirect avenues of communication with IMCO do exist through the Society's liaison with Shipowners' and Shipbuilders' National and International Institutions, etc. The Society's views can often be expressed through the medium of these institutions, provided they have consultative status with IMCO (*see* Annex 4).

By reason of these various means of contact with IMCO, the Society is not only in the happy position of being able to contribute from its accumulated knowledge but it can also gain information from delegates on the intentions and attitudes of many Administrations to various technical problems. Information of this nature is of particular value in gauging and predicting the possible outcome of matters being actively discussed at IMCO, and the Society is, thereby, enabled to assess the type and scope of service expected of it in subsequent years. Early indications of trends is of vital importance in respect of the development of new designs for ships and their equipment, in the appraisal of new designs and plans, and in taking steps to advise the Society's clients and field Surveyors of the possible introduction of new, or changes in existing, recommendations and/or legislation.

It may be concluded that, despite IMCO's work being initially viewed with a jaundiced eye, it is now evident that the Society will become increasingly involved with certification of one kind or another resulting from IMCO recommendations.

Lloyd's Register of Shipping's relation with IACS

The Society, in becoming a party to the IACS Charter, is naturally committed to the policies of that Association. This commitment involves attendance by the Society's representatives at meetings of the Council and at the nine subsidiary working parties, as shown in Fig. IV, and their involvement in the work of the three Correspondence Groups.

The terms of reference and the order of priorities for the working parties and correspondence groups are determined by the Council and cover technical matters usually arising from the proposed work programme of IMCO.

In the dicussions within the working parties it falls to the representatives of the various IACS Members to endeavour to establish a common view which, after endorsement by the Council, can be expressed by the Association's appointed observer at IMCO.

Meetings of the working parties are normally held in the country of the Society which holds the Chairmanship of the particular working party concerned.

The obligation to assist the Association in keeping abreast or preferably ahead of IMCO can, therefore, be burdensome in terms of staff time and travel involved.

At present, IACS is deeply committed to the following up of developments resulting from the workings of the Inter-Governmental Maritime Consultative Organisation. Work in this respect is urgent and takes precedence over other matters which, understandably, is reflected in the Society's relations with IACS.

In the establishment of IACS statements for IMCO, it will almost inevitably follow that an appreciable measure of unification of requirements will develop. The Society, in its

relations with IACS, is, in fact, endeavouring to establish unification, wherever this is possible, *provided* it is satisfied regarding the technical validity and safety aspects of such unification. Considerable progress has been made in this direction and it can be expected that the rate of unification of various requirements will, in the future, be accelerated. Expectations of this nature must provide welcome news to shipbuilders, who, for a considerable period, have exerted pressure in this direction. These good tidings for shipbuilders can be further enhanced, by the knowledge that Lloyd's Register of Shipping is prepared to adopt ISO and IEC standards wherever possible and will press this view within IACS.

The Possible Influence of IMCO and IACS on the Future Role of the Society and its Surveyors

It must be admitted that the title of this paper does not lead readers to expect predictions to be made on the future role of the Society, nor of its Surveyors. In fact, when the original draft was written it was not intended to do so, however, it would be somewhat naive to avoid, at least some comments on the thoughts of those dealing with IMCO and IACS affairs, as to what the future may hold in store.

The IMCO Convention came into force some 15 years ago. Since that time, this particular Organisation has exerted an increasingly profound effect upon the requirements for international shipping. In that section of shipping activity in which we are especially interested, namely classification, the effects of IMCO impinges on the basis of classification and upon the tasks undertaken by the Societies, particularly the independent Classification Societies, that is, those free from governmental control.

A comprehensive list of the resolutions adopted by IMCO up to and including the last Assembly meeting, held in October 1971, has been included as Annex 1. It is hoped that this list will serve as a useful reference, but in addition it illustrates the depth and range of subjects dealt with by that Organisation. It is interesting to observe that these resolutions, when plotted as in Fig. VI follow an exponential trend and give rise to rather frightening prospects for the future. It should be noted that the Resolutions themselves do not include nor indicate the full effects of Conventions and Codes already in force or which may come into force in the foreseeable future (*see* Fig. III).

The result of the deliberations and resolutions evolved by IMCO has been to impose a significant increase in work carried out by Classification Societies. The extra burden has, in the main, related to a greater involvement in inspections

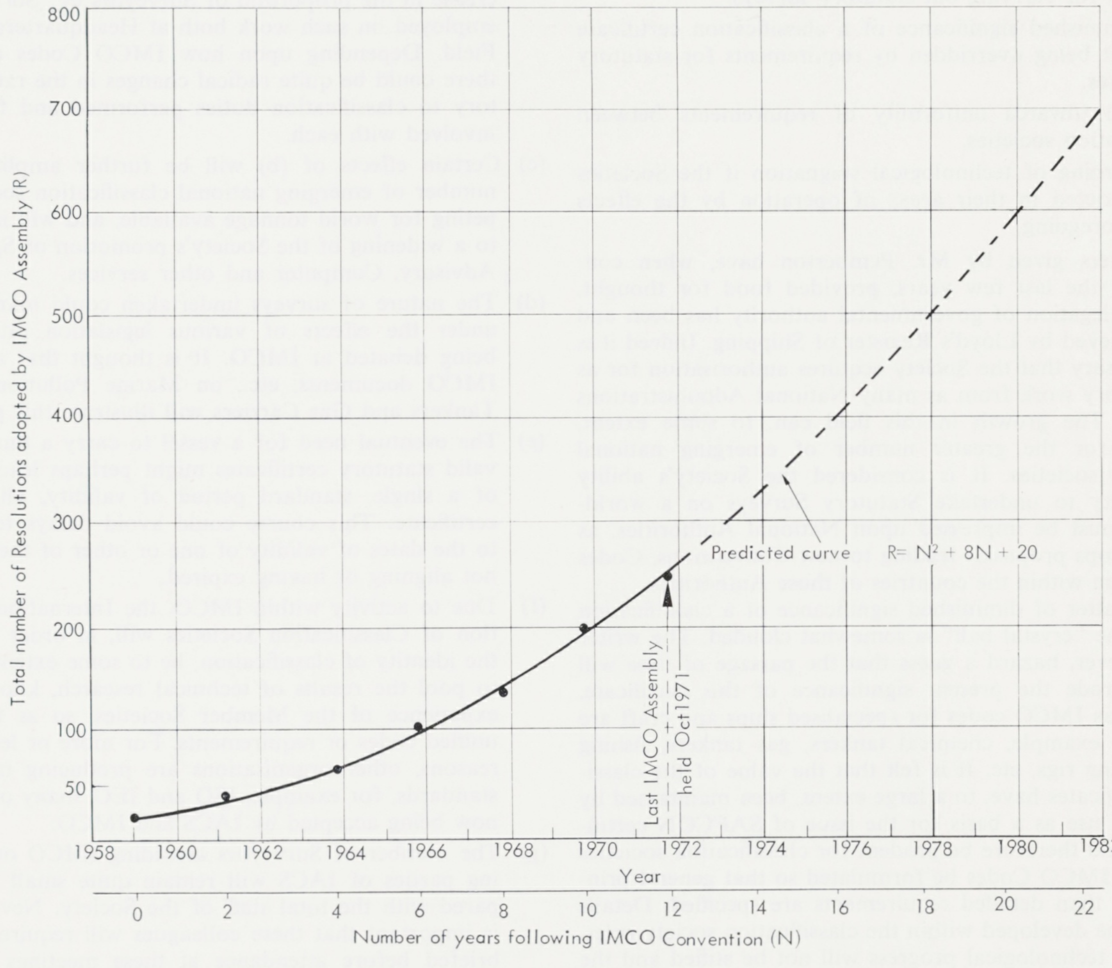


FIG. VI

and work at Headquarters leading to the issue of Statutory Certificates on behalf of National Authorities. This position has, perhaps, resulted from the Authorities not having available to them the necessary technical skills, resources nor surveying staff. The International Conventions Department at Headquarters has borne the brunt of the onslaught associated with statutory work, as can be seen by the fact that it has been found necessary to almost quadruple staff of that department over the same period in which IMCO has been operational. The substantial increase in the number of certificates issued underlines the increased delegation from National Administrations and, no doubt, colleagues at Outports throughout the world, have felt repercussions of this additional work. Other H.Q. Departments have, to a greater or lesser degree, also been involved with some of the work arising from proposals being considered by IMCO.

Many readers will, no doubt, be aware that the Society's Chief Engineer Surveyor in 1966, Mr. H. N. Pemberton, presented to the North East Coast Institution of Engineers and Shipbuilders, a paper entitled "Modern Trends in Classification Procedure". It is now interesting to review some of the points which he made regarding the effect of legislation arising from Conventions, etc., for which IMCO is the depositary. Amongst these points were: —

Increased delegation of governmental authority to the Societies for carrying out statutory surveys.

The diminished significance of a classification certificate due to it being overridden by requirements for statutory certificates.

A trend towards uniformity of requirements between classification societies.

The warning of technological stagnation if the Societies are restricted in their areas of operation by the effects of the foregoing.

The pointers given by Mr. Pemberton have, when considered over the last few years, provided food for thought. Increased delegation of governmental authority has been and is being achieved by Lloyd's Register of Shipping. Indeed it is vitally necessary that the Society acquires authorisation for as much statutory work from as many National Administrations as possible. The growth in this field can, to some extent, compensate for the greater number of emerging national classification societies. It is considered the Society's ability and capability to undertake Statutory Surveys on a worldwide basis must be impressed upon National Authorities, as IMCO develops proposals leading to new Conventions, Codes and legislation within the countries of those Authorities.

On the matter of diminished significance of a classification certificate, the "crystal ball" is somewhat clouded. The writer would, however, hazard a guess that the passage of time will eventually erode the present significance of this certificate, particularly as IMCO codes for specialised ships and craft are evolved, for example, chemical tankers, gas tankers, fishing vessels, drilling rigs, etc. It is felt that the value of the classification certificates have, to a large extent, been maintained by their present use as a basis for the issue of SAFCON certificates. It would therefore be prudent for classification societies to seek that IMCO Codes be formulated so that general principles rather than detailed requirements are specified. Details can always be developed within the classification society rules. In this way, technological progress will not be stifled and the value of the classification certificate can be maintained.

The trend towards uniformity of requirements between classification societies is now well established. The description earlier in this paper of "Lloyd's Register's relations with IACS" shows how the Society together with other Member Societies of IACS, is, through the influence of IMCO, committed to this course, from which there is apparently little chance of deviation or retreat. The future role of the Society in this respect has therefore been determined. Annex 3 provides details of the degree of unification of requirements so far achieved, together with a list of agreed IACS statements. It is hoped the inclusion of this information will serve for reference purposes. It should be noted that in a limited number of cases reservations have been recorded by some IACS Members.

To summarise, it can be restated or assumed that within the forseeable future, the influence of IMCO and IACS will be to motivate some or all of the following: —

(a) Countries throughout the world involved in marine matters will introduce an increasing volume of legislation resulting from the formulation by IMCO of Resolutions, Conventions and Codes, etc. (*see* Annex 2).

(b) The increase in Statutory requirements for ships and allied craft will, in turn, result in Lloyd's Register of Shipping being authorised, to a rapidly growing extent, to undertake surveys and to issue certificates on behalf of countries introducing such legislation. In this respect it can be further anticipated that there will be a considerable increase in the proportion of Surveyors or "Surveyor time" employed on such work both at Headquarters and in the Field. Depending upon how IMCO Codes are evolved there could be quite radical changes in the ratio of statutory to classification duties performed and fee earnings involved with each.

(c) Certain effects of (b) will be further amplified by the number of emerging national classification societies competing for world tonnage available, and will in turn, lead to a widening of the Society's promotion of Specification, Advisory, Computer and other services.

(d) The nature of surveys undertaken could markedly alter, under the effects of various legislation introduced or being debated at IMCO. It is thought that reference to IMCO documents, etc., on Marine Pollution, Chemical Tankers and Gas Carriers will illustrate this point.

(e) The eventual need for a vessel to carry a multiplicity of valid statutory certificates might perhaps lead to the use of a single, standard period of validity, all embracing certificate. This course could avoid delays to ships due to the dates of validity of one or other of the certificates not aligning or having expired.

(f) Due to activity within IMCO, the International Association of Classification Societies will, in order to preserve the identity of classification, be to some extent compelled to pool the results of technical research, knowledge and experience of the Member Societies, so as to produce, unified codes or requirements. For more or less the same reasons, other organisations are producing international standards, for example, ISO and IEC, many of which are now being accepted by IACS and IMCO.

(g) The number of Surveyors attending IMCO or the working parties of IACS will remain quite small when compared with the total staff of the Society. Nevertheless, it is important that these colleagues will require to be well briefed before attendance at these meetings and to be acquainted with the meeting procedures for both organisations. Details are always available at Headquarters.

To conclude these various views on the Society's future with the organisations, IMCO and IACS, attention might be directed towards weaknesses which become apparent when one observes the routine working of the Inter-Governmental Maritime Consultative Organisation. These weaknesses can include:—

(i) The achievement of the best technical solutions being somewhat thwarted due to rational debates being hindered by delegates receiving too rigid instructions from their governments.

(ii) Political overtones and groupings entering into technical matters.

(iii) Resolutions being adopted at the Assembly Meetings by voting, where each Member State has one vote. The voting may appear democratic but it certainly has no connection with either tonnage distribution or shipbuilding capacity in the various countries.

(iv) The considerable time lag that generally occurs between IMCO resolutions being adopted and their being introduced as legislation by the Member States. The time delay often places the Society in a position of arbitrating on possible stautory requirements arising from IMCO resolutions.

On the grounds of the foregoing it will be clearly seen that for the benefit of the industry generally there is a compelling necessity that the politically unbiased and completely independent experience and expertise of the Society, be pressed through the Working Parties and Council of IACS to the various sub-committees of IMCO.

In the political arena of the IMCO Assembly it is considered essential for effectiveness that all IACS submissions or statements are made previously in written form which can then be strongly presented at the actual meeting.

If the Societies representatives, as they are involved, can follow such procedures then the relations which exist between the three bodies will serve well the shipping community of the world in the circumstances prevailing today.

ANNEX 1

RESOLUTIONS ADOPTED BY IMCO SINCE ITS ESTABLISHMENT

Resolution* No.	Title	Date Adopted
A.1(I)	Approval of the Appointment of the Secretary-General by the Council	9 Jan 1959
A.2(I)	Acceptance of Duties under the International Convention for the Safety of Life at Sea (1948)—Revision of the Regulations for Preventing Collisions at Sea (1948)	9 Jan 1959
A.3(I)	Acceptance of Duties in connection with the International Code of Signals	9 Jan 1959
A.4(I)	Acceptance of Duties in connection with the Establishment of the Group of Experts on the Unification of Maritime Tonnage Measurement	9 Jan 1959
A.5(I)	Status of the Convention on IMCO	12 Jan 1959
A.6(I)	Report of the Credentials Committee	13 Jan 1959
A.7(I)	Agreement on Relationship with the United Nations	13 Jan 1959
A.8(I)	Acceptance of Duties under the International Convention for the Prevention of Pollution of the Sea by Oil (1954)	13 Jan 1959
A.9(I)	Election of Members of the Maritime Safety Committee, as provided in Article 28 of the Convention	15 Jan 1959
A.10(I)	Report of the Assembly on the Final Text of the Annex to the General Convention on the Privileges and Immunities of the Specialised Agencies	16 Jan 1959
A.11(I)	Relationship with other Specialised Agencies and other Internation Organisations	16 Jan 1959
A.12(I)	Election of Members of the Maritime Safety Committee	19 Jan 1959
A.13(I)	Adoption of Rules of Procedure for subsequent Sessions of the Assembly	19 Jan 1959
A.14(I)	Financial Regulations of the Inter-Governmental Maritime Consultative Organisation	19 Jan 1959
A.15(I)	Staff Regulations of the Inter-Governmental Maritime Consultative Organisation	19 Jan 1959
A.16(I)	Review of Expenditures and Approval of Accounts of the Preparatory Committee	19 Jan 1959
A.17(I)	Dissolution of the Preparatory Committee	19 Jan 1959
A.18(I)	Staff Establishment and Adoption of the Budget for the first financial period	19 Jan 1959
A.19(I)	Staff Establishment and Adoption of the Budget for the first financial period	19 Jan 1959
A.20(I)	Apportionment of Expenses among Member States	19 Jan 1959
A.21(II)	Report on Request by the first Assembly for an Advisory Opinion of the International Court of Justice on the constitution of the Maritime Safety Committee	6 Apr 1961
A.22(II)	Presentation of the Report of the Council, in accordance with Article 24 of the Convention	6 Apr 1961
A.23(II)	Approval of appointment of External Auditor	6 Apr 1961
A.24(II)	Programme appraisal in the economic, social and human rights fields	13 Apr 1961

Resolution* No.	Title	Date Adopted
A.25(II)	General Convention on Privileges and Immunities of the Specialised Agencies	11 Apr 1961
A.26(II)	Admission of new Member States—The Islamic Republic of Mauritania	13 Apr 1961
A.27(II)	Adoption of the Rules of Procedure	13 Apr 1961
A.28(II)	Participation in the United Nations Expanded Programme of Technical Assistance	13 Apr 1961
A.29(II)	Facilitation of Travel and Transport	13 Apr 1961
A.30(II)	Consideration of Agreement between International Atomic Energy Agency and Inter-Governmental Maritime Consultative Organisation	13 Apr 1961
A.31(II)	Approval of the Rules for the Admission to Consultative Status of Non-Governmental international organisations	13 Apr 1961
A.32(II)	Amendment to the Financial Regulations	13 Apr 1961
A.33(II)	Work Programme of the Organisation	13 Apr 1961
A.34(II)	Staff Establishment and Adoption of the Budget for the second financial period 1962/63	13 Apr 1961
A.35(II)	Staff Establishment and Adoption of the Budget for the second financial period 1962/63—Amendment to the Staff Regulations	13 Apr 1961
A.36(II)	Staff Establishment and Adoption of the Budget for the first financial period—Supplementary Estimates for 1961	13 Apr 1961
A.37(II)	Staff Establishment and Adoption of the Budget for the second financial period 1962/63—Working Capital Fund	13 Apr 1961
A.38(II)	Apportionment of expenses among Member States	13 Apr 1961
A.39(II)	United Nations Joint Staff Pension Fund	13 Apr 1961
A.40(II)	Report on Request by the first Assembly for an Advisory Opinion of the International Court of Justice on the constitution of the Maritime Safety Committee	13 Apr 1961
A.41(II)	Presentation of the Report of the Maritime Safety Committee, transmitted by the Council	14 Apr 1961
A.42(II)	Approval of the Provisional Consultative Status granted to Non-Governmental International Organisations by the Council	14 Apr 1961
A.43(II)	Determination of date and place of the third session of the Assembly, in 1963	14 Apr 1961
A.44(ES.I)	Approval of the appointment of the Secretary-General by the Council	10 Jan 1963
A.45(III)	Banning of nuclear tests in the atmosphere, in outer space and under water	18 Oct 1963
A.46(III)	Approval of the appointment of the External Auditor	18 Oct 1963
A.47(III)	Red Sea Lights	18 Oct 1963
A.48(III)	Approval of the Recommendation of the Maritime Safety Committee on treatment of shelter deck and other "open" spaces	18 Oct 1963
A.49(III)	Approval of the Recommendation of the Maritime Safety Committee on stability information for ships carrying grain	18 Oct 1963
A.50(III)	Approval of the Recommendation of the Maritime Safety Committeee on marking of oceanographic stations	18 Oct 1963

Resolution* No.	Title	Date Adopted
A.51(III)	Acceptance by the Organisation of additional duties consequent upon the International Conference on Prevention of Pollution of the Sea by Oil, 1962	18 Oct 1963
A.52(III)	Intact stability of fishing vessels	24 Oct 1963
A.53(III)	Convening of the international conference on load-lines	24 Oct 1963
A.54(III)	Adoption of the Reports of the Maritime Safety Committee	24 Oct 1963
A.55(III)	General Convention on the Privileges and Immunities of the Specialised Agencies	25 Oct 1963
A.56(III)	Relations with the Host State	25 Oct 1963
A.57(III)	Relationship with the UN, specialised agencies, IAEA and other international organisations	25 Oct 1963
A.58(III)	Relations with the non-governmental international organisations: review of the list of non-governmental international organisations in consultative status; relations with the International Maritime Committee	25 Oct 1963
A.59(III)	Amendment to the Financial Regulations	25 Oct 1963
A.60(III)	Review of expenditure and approval of accounts	25 Oct 1963
A.61(III)	IMCO headquarters accommodation	25 Oct 1963
A.62(III)	Participation in the United Nations Expanded Programme of Technical Assistance	25 Oct 1963
A.63(III)	Facilitation of travel and transport	25 Oct 1963
A.64(III)	Work programme of the Organisation	25 Oct 1963
A.65(III)	Staff establishment and adoption of the budget for the third financial period 1964/65	25 Oct 1963
A.66(III)	Staff establishment and adoption of the budget for the third financial period 1964/65; Working Capital Fund	25 Oct 1963
A.67(III)	Apportionment of expenses among Member States	25 Oct 1963
A.68(III)	Determination of date and place of the fourth session of the Assembly in 1965	25 Oct 1963
A.69(ES.II)	Amendments to Articles 17, 18 and 28 of the IMCO Convention	15 Sep 1964
A.70(IV)	Amendment to Article 28 of the Convention on the Inter-Governmental Maritime Consultative Organisation	28 Sep 1965
A.71(IV)	Amendments to the Rules of Procedure of the Assembly consequent upon Amendments to Articles 17, 18 and 28 of the IMCO Convention	28 Sep 1965
A.72(IV)	Amendment to Rule 3 and Rule 9 of the Rules of Procedure of the Assembly	28 Sep 1965
A.73(IV)	Presentation of the Final Accounts and Audit Report for the Second Financial Period	22 Sep 1965
A.74(IV)	Working Capital Fund	24 Sep 1965
A.75(IV)	Amendments of the Financial Regulations	22 Sep 1965
A.76(IV)	Apportionment of Expenses among Member States	24 Sep 1965
A.77(IV)	Arrears of Contributions	24 Sep 1965
A.78(IV)	Facilitation of Travel and Transport	27 Sep 1965

Resolution* No.	Title	Date Adopted
A.79(IV)	Arrangements for an International Conference on Load Lines in 1966	24 Sep 1965
A.80(IV)	International Code of Signals	27 Sep 1965
A.81(IV)	Approval of the International Maritime Dangerous Goods Code	27 Sep 1965
A.82(IV)	Approval of the Code of Safe Practice for Bulk Cargoes	28 Sep 1965
A.83(IV)	Acceptance of the International Convention for the Safety of Life at Sea, 1960, and of the International Regulations for Preventing Collisions at Sea, 1960	27 Sep 1965
A.84(IV)	Prevention of Pollution of the Sea by Oil	27 Sep 1965
A.85(IV)	Prevention of Pollution of the Sea by Agents other than Oil	27 Sep 1965
A.86(IV)	Implementation of the recommendations on treatment of Shelter deck and other "open" spaces	27 Sep 1965
A.87(IV)	Convening of an International Conference on tonnage measurement	27 Sep 1965
A.88(IV)	Intact stability of Fishing Vessels	27 Sep 1965
A.89(IV)	Training of Seafarers	27 Sep 1965
A.90(IV)	Navigation in the Strait of Dover	27 Sep 1965
A.91(IV)	Emergency Position—Indicating Radio Beacons	27 Sep 1965
A.92(IV)	Radiocommunication requirements for the Ocean Data Service of the Inter-Governmental Oceanographic Commission	27 Sep 1965
A.93(IV)	Lights and Shapes for Dracones	27 Sep 1965
A.94(IV)	Nuclear Ships	27 Sep 1965
A.95(IV)	Weather Messages in Oceanic Areas	27 Sep 1965
A.96(IV)	Red Sea Lights	27 Sep 1965
A.97(IV)	Adoption of the Report of the Maritime Safety Committee	28 Sep 1965
A.98(IV)	Work Programme	24 Sep 1965
A.99(IV)	Work Programme of the Organisation	24 Sep 1965
A.100(IV)	Printing Fund	24 Sep 1965
A.101(IV)	Budget for the Fourth Financial Period 1966/67: Staff Establishment	24 Sep 1965
A.102(IV)	Participation in the United Nations Expanded Programme of Technical Assistance	27 Sep 1965
A.103(IV)	Agreement between FAO and IMCO	27 Sep 1965
A.104(IV)	Relations with the Host State	24 Sep 1965
A.105(IV)	Relations with non-Governmental Organisations	27 Sep 1965
A.106(IV)	Status of the IMCO Convention	28 Sep 1965
A.107(IV)	Broadcasts from Stations outside territorial waters	28 Sep 1965
A.108(ES.III)	Amendments to Chapter II of the International Convention for the Safety of Life at Sea, 1960	30 Nov 1966
A.109(ES.III)	Recommendation to put fire safety measures into effect	30 Nov 1966
A.110(ES.III)	Recommendations for fire safety measures for all passenger ships	30 Nov 1966
A.111(V)	Amendments to Articles 17, 18 and 28 of the Convention: consequential amendments to the Rules of Procedure of the Assembly	17 Oct 1967
A.112(V)	Approval of the appointment of the Secretary-General by the Council	17 Oct 1967

Resolution* No.	Title	Date Adopted
A.113(V)	Revised International Code of Signals	25 Oct 1967
A.114(V)	Implementation of the Recommendations on the treatment of shelter deck and other "open" spaces and acceptance of tonnage certificates	25 Oct 1967
A.115(V)	Recommendation on the treatment of spaces on board ships for the separation, clarification or purification, and the carriage of slop oil	25 Oct 1967
A.116(V)	Arrangements with the Food and Agriculture Organisation of the United Nations (FAO) and the International Labour Organisation (ILO)	25 Oct 1967
A.117(V)	Broadcasts from stations outside territorial waters	25 Oct 1967
A.118(V)	Maritime World Administrative Radio Conference	25 Oct 1967
A.119(V)	Prevention of pollution of the sea by oil	25 Oct 1967
A.120(V)	International Maritime Dangerous Goods Code	25 Oct 1967
A.121(V)	Examination of the Reports submitted to the Organisation under Regulation 19 of Chapter I of the International Convention for the Safety of Life at Sea, 1960	25 Oct 1967
A.122(V)	Amendments to the International Convention for the Safety of Life at Sea, 1960	25 Oct 1967
A.123(V)	Recommendation on fixed fire extinguishing systems for special category spaces	25 Oct 1967
A.124(V)	Recommendation on crew training	25 Oct 1967
A.125(V)	Recommendation on periodical inspection of musters	25 Oct 1967
A.126(V)	Recommendation on life-saving appliances for hydrofoil boats	25 Oct 1967
A.127(V)	Recommendation on signals by emergency position-indicating radio beacons	25 Oct 1967
A.128(V)	Recommendation on VHF radiotelephone stations	25 Oct 1967
A.129(V)	Recommendation on emergency radiotelegraph transmitters on vessels of less than 1600 tons gross when on transoceanic voyages.	25 Oct 1967
A.130(V)	Recommendation on pilot ladders on fishing vessels and vessels of less than 500 ton gross	25 Oct 1967
A.131(V)	Recommendation on the application of certain Rules of the International Regulations for Preventing Collisions at Sea, 1960	25 Oct 1967
A.132(V)	Recommendation on additional signals to be used by vessels fishing in close proximity	25 Oct 1967
A.133(V)	International Conference on Load Lines, 1966	25 Oct 1967
A.134(V)	International Conference on Tonnage Measurement	25 Oct 1967
A.135(V)	Adoption of the Reports of the Maritime Safety Committee	25 Oct 1967
A.136(V)	Facilitation of travel and transport: standardised forms of documents	26 Oct 1967
A.137(V)	Working Capital Fund	26 Oct 1967
A.138(V)	Appointment of an external auditor	26 Oct 1967
A.139(V)	World Weather Watch	26 Oct 1967
A.140(V)	Participation of the Inter-Governmental Maritime Consultative Organisation in the United Nations Development Programme	26 Oct 1967
A.141(V)	Presentation of the Final Accounts and Audit Report for the Third Financial Period	26 Oct 1967

Resolution* No.	Title	Date Adopted
A.142(V)	Work Programme and Budget for the Fifth Financial Period 1968/69	26 Oct 1967
A.143(V)	Relations with the Non-Governmental Organisations	26 Oct 1967
A.144(V)	Simla Rules	26 Oct 1967
A.145(V)	Appreciation of the Services of M. Jean Georges Roullier to the Organisation	26 Oct 1967
A.146(ES.IV)	Amendments to the International Convention for the Safety of Life at Sea, 1960	26 Nov 1968
A.147(ES.IV)	Reports on Accidents Involving Significant Spillages of Oil	26 Nov 1968
A.148(ES.IV)	National Arrangements for Dealing with Significant Spillages of Oil	26 Nov 1968
A.149(ES.IV)	Regional Co-operation in Dealing with Significant Spillages of Oil	26 Nov 1968
A.150(ES.IV)	Research and Exchange of Information on Methods for Disposal of Oil in Cases of Significant Spillages	26 Nov 1968
A.151(ES.IV)	Detection of Offences Against and Enforcement of the International Convention for the Prevention of Pollution of the Sea by Oil, 1954	26 Nov 1968
A.152(ES.IV)	Discharge of Oily mixtures Resulting from Tank Cleaning and Ballasting into the Sea	27 Nov 1968
A.153(ES.IV)	Penalties for Unlawful Discharge of Oil into the Sea	27 Nov 1968
A.154(ES.IV)	Oil Reception Facilities	27 Nov 1968
A.155(ES.IV)	Prevention of Pollution of the Sea by Oil outside the Prohibited Zones	27 Nov 1968
A.156(ES.IV)	Recommendation on the Carriage of Electronic Position-Fixing Equipment	27 Nov 1968
A.157(ES.IV)	Recommendation on the Use and Testing of Shipborne Navigational Equipment	27 Nov 1968
A.158(ES.IV)	Recommendation on Port Advisory Services	27 Nov 1968
A.159(ES.IV)	Recommendation on Pilotage	27 Nov 1968
A.160(ES.IV)	Recommendation on Data concerning Manœuvring Capabilities and Stopping Distances of Ships	27 Nov 1968
A.161(ES.IV)	Recommendation on Establishing Traffic Separation Schemes and Areas to be Avoided by Ships of Certain Classes	27 Nov 1968
A.162(ES.IV)	Recommendation on Additional Signals for Deep-Draught Ships in Narrow Channels	28 Nov 1968
A.163(ES.IV)	Recommendation for Fire Test Procedures for "A" and "B" Class Divisions	28 Nov 1968
A.164(ES.IV)	Recommendation Concerning Checking the Constancy of the Properties of Materials	28 Nov 1968
A.165(ES.IV)	Provisional Guidelines on Test Procedures for Deck Coverings	28 Nov 1968
A.166(ES.IV)	Guidelines on the Evaluation of Fire Hazard Properties of Materials	28 Nov 1968
A.167(ES.IV)	Recommendation on Intact Stability for Passenger and Cargo Ships under 100 metres in Length	28 Nov 1968
A.168(ES.IV)	Recommendation on Intact Stability of Fishing Vessels	28 Nov 1968
A.169(ES.IV)	Recommendation for Testing Life-Jackets	28 Nov 1968
A.170(ES.IV)	Recommendation on Life-Saving Appliances for Air-Cushion Vehicles	28 Nov 1968
A.171(ES.IV)	Convening of a Conference on "Torrey Canyon" Matters	28 Nov 1968

Resolution* No.	Title	Date Adopted
A.172(ES.IV)	Recommendation for Uniform Application and Interpretation of Regulation 27 of the International Convention on Load Lines, 1966	28 Nov 1968
A.173(ES.IV)	Participation in Official Inquiries into Maritime Casualties	28 Nov 1968
A.174(VI)	Amendments to the International Convention for the Safety of Life at Sea, 1960	21 Oct 1969
A.175(VI)	Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954	21 Oct 1969
A.176(VI)	Marine Pollution	21 Oct 1969
A.177(VI)	Recommendation on Recommended Practices for Navigation Lights	28 Oct 1969
A.178(VI)	Recommendation on Positioning of Navigation Lights	28 Oct 1969
A.179(VI)	Recommendation on Establishment of Fairways through Off-Shore Exploration Areas	28 Oct 1969
A.180(VI)	Recommendation on Dissemination of Information, Charting and Manning of Drilling Rigs and Production Platforms	28 Oct 1969
A.181(VI)	Instructions on Survival in Life Rafts	28 Oct 1969
A.182(VI)	Safety Radiocommunication requirements for Drilling and Production Platforms and Similar Units	28 Oct 1969
A.183(VI)	Recommendation on Fire Safety Measures for Hydrofoil Boats	28 Oct 1969
A.184(VI)	Adoption of Grain Regulations as an Equivalent to Chapter VI of the International Convention for the Safety of Life at Sea, 1960	28 Oct 1969
A.185(VI)	Application of Grain Regulations to Cargo Ships of Less than 500 tons Gross Tonnage	28 Oct 1969
A.186(VI)	Recommendation on Establishing Additional Traffic Separation Schemes and Areas to be Avoided by Ships of Certain Classes	28 Oct 1969
A.187(VI)	Procedure for Amending and Bringing up to Date the International Code of Signals	28 Oct 1969
A.188(VI)	Training of Masters, Officers and Crew	28 Oct 1969
A.189(VI)	Voluntary Reports on Spillages of Oil	28 Oct 1969
A.190(VI)	Adoption of the Reports of the Maritime Safety Committee	28 Oct 1969
A.191(VI)	International Conference on Tonnage Measurement of Ships, 1969	28 Oct 1969
A.192(VI)	Revision of the Regulations for Preventing Collisions at Sea, 1960	28 Oct 1969
A.193(VI)	International Conference on Container Traffic	29 Oct 1969
A.194(VI)	Recommendation on Wider Implementation of Facilitation Measures in Maritime Travel and Transport	29 Oct 1969
A.195(VI)	Review of the Organisation's Methods of Work and the Total Financial Burden Falling upon Member States	29 Oct 1969
A.196(VI)	Working Capital Fund	29 Oct 1969
A.197(VI)	Presentation of the Final Accounts and Audit Report for the Fourth Financial Period	29 Oct 1969
A.198(VI)	Work Programme and Budget for the Sixth Financial Period 1970/71	29 Oct 1969
A.199(VI)	Relations with the non-Governmental Organisations	29 Oct 1969
A.200(VI)	Printing Fund	29 Oct 1969
A.201(VI)	International Labour Organisation (ILO)	29 Oct 1969

Resolutions* No.	Title	Date Adopted
A.202(VII)	International Conference on Special Trade Passenger Ships, 1971	6 Oct 1971
A.203(VII)	Recommendation on the Conclusion of Agreements and Arrangements between States on the Question of Access and Employment of Foreign Sea-borne Salvage Equipment in Territorial Waters	6 Oct 1971
A.204(VII)	Appreciation of the Services of Mr. Hjalmar R. Bardarson	11 Oct 1971
A.205(VII)	Amendments to the International Convention for the Safety of Life at Sea, 1960	12 Oct 1971
A.206(VII)	Amendments to the Recommendation on Intact Stability for Passenger and Cargo Ships under 100 metres in Length (Resolution A.167(ES.IV)) with respect to Ships Carrying Deck Cargoes	12 Oct 1971
A.207(VII)	Recommendation for an Interim Simplified Criterion for Decked Fishing Vessels under 30 metres in Length	12 Oct 1971
A.208(VII)	Recommendation on Construction of Fishing Vessels Affecting the Vessel's Stability and Crew Safety	12 Oct 1971
A.209(VII)	Recommendation on Information to be Included in the Manœuvring Booklets	12 Oct 1971
A.210(VII)	Recommendation on Steering Gear for Large Ships	12 Oct 1971
A.211(VII)	Recommendation on Safety Measures for Periodically Unattended Machinery Spaces of Cargo Ships Additional to those normally Considered Necessary for an Attended Machinery Space	12 Oct 1971
A.212(VII)	Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk	12 Oct 1971
A.213(VII)	Recommendation on Fire Safety Requirements for Construction and Equipment of New Tankers	12 Oct 1971
A.214(VII)	Improved Provisional Guidelines on Test Procedures for Primary Deck Coverings	12 Oct 1971
A.215(VII)	Correction to the Text of the Recommendation for Fire Test Procedures for "A" and "B" Class Divisions (Resolution A.163(ES.IV))	12 Oct 1971
A.216(VII)	Instruction for Action in Survival Craft	12 Oct 1971
A.217(VII)	Measures for Strengthening and Improving the Maritime Distress System	12 Oct 1971
A.218(VII)	Safety Radiocommunication Requirements for Novel Types of Craft	12 Oct 1971
A.219(VII)	Unification of Performance Specifications	12 Oct 1971
A.220(VII)	Introduction of Selective Calling (SSFC) System	12 Oct 1971
A.221(VII)	Radio Equipment for Homing	12 Oct 1971
A.222(VII)	Performance Standards for Navigational Radar Equipment	12 Oct 1971
A.223(VII)	Performance Standards for Radio Direction-Finding Systems	12 Oct 1971
A.224(VII)	Performance Standards for Echo-Sounding Equipment	12 Oct 1971
A.225(VII)	Homing Capability of Search and Rescue (SAR) Aircraft	12 Oct 1971
A.226(VII)	Traffic Separation Schemes	12 Oct 1971
A.227(VII)	System of Traffic Separation Schemes in the Dover Strait and Adjacent Areas	12 Oct 1971
A.228(VII)	Observance of Traffic Separation Schemes	12 Oct 1971
A.229(VII)	Merchant Ship Search and Rescue Manual (MERSAR)	12 Oct 1971

Resolution* No.	Title	Date Adopted
A.230(VII)	Adoption of the International Maritime Dangerous Goods Code	12 Oct 1971
A.231(VII)	Amendments to the International Convention on Load Lines, 1966	12 Oct 1971
A.232(VII)	Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 (as amended in 1969), Concerning the Protection of the Great Barrier Reef	12 Oct 1971
A.233(VII)	Recommendation on International Performance Specifications for Oily-Water Separating Equipment and Oil Content Meters	12 Oct 1971
A.234(VII)	Disposal of Oily Bilge and Ballast Water from Ships in Ports (excluding Effluent from Cargo/Ballast Tanks in Tankers)	12 Oct 1971
A.235(VII)	Facilities in Ports for the Reception of Oil Residues	12 Oct 1971
A.236(VII)	Implementation of the 1969 Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954	12 Oct 1971
A.237(VII)	Acceleration of the Maritime Safety Committee's Work Programme	12 Oct 1971
A.238(VII)	Adoption of the Reports of the Maritime Safety Committee	12 Oct 1971
A.239(VII)	Recommendation on Facilitation in Maritime Travel and Transport	12 Oct 1971
A.240(VII)	Working Capital Fund	12 Oct 1971
A.241(VII)	International Conference on Marine Pollution, 1973	13 Oct 1971
A.242(VII)	Preparation for the United Nations Conference on the Human Environment (Stockholm, 5–16 June, 1972)	13 Oct 1971
A.243(VII)	International Convention on Ocean Data Acquisition Systems (ODAS)	13 Oct 1971
A.244(VII)	Co-operation with the Intergovernmental Oceanographic Commission	13 Oct 1971
A.245(VII)	United Nations/IMCO Conference on International Container Traffic, 1972	15 Oct 1971
A.246(VII)	Amendments to the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, Concerning Tank Arrangements and Limitation of Tank Size	15 Oct 1971
A.247(VII)	Recommendation to Put into Effect Requirements relating to Tank Arrangements and to the Limitation of Tank Size from the Point of View of Minimising Pollution of the Sea by Oil	15 Oct 1971
A.248(VII)	Long-Term Work Programme of the Organisation	15 Oct 1971
A.249(VII)	Amendment Procedures in Conventions for which IMCO is Depositary	15 Oct 1971
A.250(VII)	Implementation of United Nations General Assembly Resolutions on Apartheid and on the Declaration of the Granting of Independence to Colonial Countries and Peoples	15 Oct 1971
A.251(VII)	Relations with Non-Governmental International Organisations	15 Oct 1971
A.252(VII)	Presentation of the Final Accounts and Audit Report for the Fifth Financial Period	15 Oct 1971
A.253(VII)	Amendment to the Financial Regulations	15 Oct 1971
A.254(VII)	Supplementary Estimates for 1971	15 Oct 1971
A.255(VII)	Work Programme and Budget for the Seventh Financial Period 1972/73	15 Oct 1971
A.256(VII)	Continuation of the Joint Inspection Unit	15 Oct 1971
A.257(VII)	Appointment of the External Auditor	11 Oct 1971
A.258(VII)	Approval of the Appointment of the Secretary-General by Council	15 Oct 1971

* A=Assembly (ES.I)=Extraordinary Session. First (I)=First Session, etc.

ANNEX 2

STATUS OF THE IMCO CONVENTION AND OF ALL CONVENTIONS AND ACTS OF WHICH IMCO IS DEPOSITARY

(as at 31st December, 1972)

The Convention on the Inter-Governmental Maritime Consultative Organisation, came into force on 17th March, 1958, when 21 states had become parties to the Convention. The Convention was deposited with the Secretary-General of the United Nations and the Organisation held its first Assembly Meeting in January 1959.

The various Conventions and other Instruments since deposited with IMCO are given hereunder and a consolidated list is included showing the status of each:—

— the International Convention for the Safety of Life at Sea, 1948. This Convention entered into force on 19th November, 1952.

— the International Convention for the Safety of Life at Sea, 1960. The Convention entered into force on 26th May, 1965, but the amendments adopted in 1966, 1967, 1968, 1969 and 1971 are not yet in force.

— the International Regulations for Preventing Collisions at Sea, revised by the 1960 Safety of Life at Sea Conference. These Regulations entered into force on 1st September, 1965.

— the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended in 1962. The Convention entered into force on 26th July, 1958, and the 1962 amendments entered into force on 18th May and 28th June, 1967, but the amendments adopted in 1969 and 1971 are not yet in force.

— the Convention on Facilitation of International Maritime Traffic, 1965. The Convention entered into force on 5th March, 1967. Amendments to the Annex of the Convention were proposed in 1969 and entered into force on 12th August, 1971.

— the International Convention on Load Lines, 1966. The Convention entered into force on 21st July, 1968, but amendments adopted in 1971 are not yet in force.

— the International Convention on Tonnage measurement of Ships, 1969. The Convention is not yet in force.

— the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 ("Public Law" Convention). The Convention is not yet in force.

— the International Convention on Civil Liability for Oil Pollution Damage, 1969 ("Private Law" Convention). The Convention is not yet in force.

— the Special Trade Passenger Ships Agreement, 1971 ("Simla" Agreement). This Agreement is not yet in force.

— the International Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material, 1971 ("Nuclear" Convention). This Convention is not yet in force.

— the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 ("Fund" Convention). This Convention is not yet in force.

— the Convention on the International Regulations for Preventing Collisions at Sea, 1972. This Convention is not yet in force.

— the International Convention for Safe Containers, 1972. This Convention is not yet in force.

CONSOLIDATED LIST OF STATES SHOWING THEIR STATUS IN RESPECT OF THE IMCO CONVENTION AND THE CONVENTIONS OR OTHER INSTRUMENTS DEPOSITED WITH IMCO (TO 31ST DECEMBER 1972)

Country	IMCO Convention	1948 SOLAS	1960 SOLAS	Amendments 1966	Amendments 1967	Amendments 1968	Amendments 1969	Amendments 1971	1960 COLREGS	1954/62 OILPOL	Amdts. 1969	Amdts. 1971* a	Amdts. 1971* b	1965 FAL (Admt. 1971)	1966 LOAD LINES	Amdt. 1971	1969 TONNAGE	1969 PUBLIC LAW	1969 PRIVATE LAW	1971 SIMLA	1971 NUCLEAR	1971 FUND	1972 COLREGS	1972 CONTAINERS
Afghanistan																								
Albania																								
Algeria	x	x	x							x														
Argentina	x		x	(x)	(x)	(x)	(x)		x						x									
Australia	x		x						x	x					x									
Austria			x						x						x									
Bahrain																								
Barbados	x																							
Belgium	x		x						x	x/x				x/x	x			(x)						
Bhutan																								
Bolivia																								
Botswana																								
Brazil	x		x	(x)	(x)	(x)			x						x		(x)							
Bulgaria	x	x	x						x						x									
Burma	x		x						x															
Burundi																								
Byelorussian SSR																								
Cameroon	x	x							x															
Canada	x		x	(x)	(x)				x	x	(x)			x/x	x									
Central African Republic		x																						
Chad		x																						
Chile	x	x	x																					
China																								
Colombia																								
Congo, People's Republic of		x																						
Costa Rica																								
Cuba	x	x	x						x						x									

Cyprus			x						x						x									
Czechoslovakia	x	x	x						x					x	x									
Dahomey		x																						
Denmark	x		x	(x)					x	x/x	(x)			x/x	x	(x)		(x)						
Dominican Republic	x	x								x				x										
Ecuador	x																							
Egypt	x		x	(x)	(x)	(x)			x	x/x	(x)				x									
El Salvador																								
Equatorial Guinea	x		x																					
Ethiopia																								
Federal Republic of Germany	x		x	(x)					x	x/x				x/x	x									
Fiji			x	(x)	(x)	(x)	(x)		x	x	(x)			x	x		(x)	(x)	(x)					
Finland	x		x	(x)					x	x/x				x/x	x									
France	x	x	x	(x)	(x)	(x)	(x)		x	x/x	(x)			x/x	x	(x)		(x)						
Gabon		x																						
The Gambia			x						x															
Ghana	x		x	(x)					x	x/x				x/x	x									
Greece	x		x	(x)		(x)			x	x				x	x									
Guatemala																								
Guinea		x	x																					
Guyana																								
Haiti	x	x	x																					
Honduras	x		x																					
Hong Kong	x[1]		x[1]						x[1]	x[1]				x[1]	x[1]									
Hungary	x	x	x																					
Iceland	x		x	(x)					x	x/x	(x)			x/x	x		(x)							
India	x		x						x						x									
Indonesia	x		x						x															
Iran	x		x																					
Iraq																	(x)							
Ireland	x	x	x						x	x/x				x	x									
Israel	x		x	(x)	(x)				x	x/x				x	x									
Italy	x	x	x	(x)					x	x				x	x									

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Country	IMCO Convention	1948 SOLAS	1960 SOLAS	Amendments 1966	Amendments 1967	Amendments 1968	Amendments 1969	Amendments 1971	1960 COLREGS	1954/62 OILPOL	Amdts. 1969	Amdts. 1971* a	Amdts. 1971* b	1965 FAL (Admt. 1971)	1966 LOAD LINES	Amdt. 1971	1969 TONNAGE	1969 PUBLIC LAW	1969 PRIVATE LAW	1971 SIMLA	1971 NUCLEAR	1971 FUND	1972 COLREGS	1972 CONTAINERS
Ivory Coast	x		x						x	x			(x)	x	x									
Jamaica			x						x															
Japan	x		x						x	x	(x)				x			(x)						
Jordan										x/x		(x)	(x)											
Kenya																								
Khmer Republic	x		x																					
Kuwait	x		x	(x)	(x)	(x)			x	x/x					x									
Laos																								
Lebanon	x		x	(x)	(x)	(x)			x	x	(x)	(x)	(x)		x									
Lesotho																								
Liberia	x		x	(x)	(x)	(x)	(x)	(x)	x	x/x	(x)	(x)	(x)		x	(x)	(x)	(x)	(x)			(x)		
Libyan Arab Republic	x									x														
Liechtenstein																								
Luxembourg																								
Malagasy Republic	x	x	x	(x)		(x)			x	x/x	(x)			x	x									
Malawi																								
Malaysia	x	x	x												x									
Maldives	x		x	(x)	(x)	(x)	(x)		x						x									
Mali		x																						
Malta	x																							
Mauritania	x	x	x												x									
Mauritius																								
Mexico	x	x	x							x					x		(x)							
Monaco		x	x	(x)	(x)	(x)			x	x				x	x		(x)							
Mongolia																								
Morocco	x	x	x	(x)					x	x					x									
Nauru			x																					
Nepal																								
Netherlands	x		x	(x)					x	x/x				x/x	x									

New Zealand	x		x						x	x					x									
Nicaragua		x	x																					
Niger		x																						
Nigeria	x	x	x						x	x				x	x									
Norway	x		x	(x)	(x)	(x)	(x)		x	x/x	(x)			x/x	x		(x)	(x)						
Oman																								
Pakistan	x		x	(x)	(x)				x						x									
Panama	x	x	x	(x)						x					x									
Paraguay			x						x															
P.D.R. of Yemen			x	(x)	(x)	(x)				x					x									
Peru	x		x	(x)					x						x									
Philippines	x		x			(x)			x	x/x					x									
Poland	x		x						x	x/x				x	x									
Portugal			x						x	x					x									
Qatar																								
Republic of Korea	x		x	(x)					x						x									
Republic of Viet Nam			x	(x)					x						x									
Romania	x		x	(x)	(x)	(x)	(x)		x						x									
Rwanda																								
San Marino																								
Saudi Arabia	x		x							x	(x)													
Senegal	x	x	x							x								(x)	(x)					
Sierra Leone																								
Singapore	x		x						x					x/x	x									
Somalia		x	x												x									
South Africa			x	(x)	(x)	(x)	(x)		x						x									
Spain	x		x		(x)	(x)			x	x					x		(x)							
Sri Lanka (Ceylon)	x																							
Sudan																								
Swaziland																								
Sweden	x	x	x	(x)					x	x/x	(x)	(x)	(x)	x/x	x									
Switzerland	x		x	(x)					x	x/x				x	x									
Syria	x		x							x														

Country	IMCO Convention	1948 SOLAS	1960 SOLAS	Amendments 1966	1967	1968	1969	1971	1960 COLREGS	1954/62 OILPOL	Amdts. 1969	1971* a	b	1965 FAL (Admt. 1971)	1966 LOAD LINES	Admt. 1971	1969 TONNAGE	1969 PUBLIC LAW	1969 PRIVATE LAW	1971 SIMLA	1971 NUCLEAR	1971 FUND	1972 COLREGS	1972 CONTAINERS
Thailand																								
Togo																								
Tonga																								
Trinidad and Tobago	x		x						x					x	x									
Tunisia	x	x	x	(x)	(x)	(x)	(x)	(x)	x					x/x	x									
Turkey	x	x	x						x						x									
Uganda																								
Ukrainian SSR																								
USSR	x	x	x						x	x	(x)			x	x		(x)							
United Arab Emirates																								
United Kingdom	x		x	(x)	(x)	(x)	(x)		x	x/x	(x)			x/x	x		(x)	(x)						
United Republic of Tanzania																								
United States of America	x		x	(x)	(x)	(x)	(x)		x	x				x/x	x									
Upper Volta																								
Uruguay	x	x	x																					
Venezuela			x							x														
Western Samoa																								
Yemen																								
Yugoslavia	x		x	(x)					x					x/x	x		(x)							
Zaire			x												x									
Zambia			x	(x)	(x)	(x)								x	x									
Totals	74	36	85	(38)	(22)	(22)	(11)	(2)	62	47/21	(15)	(4)	(5)	32/16	64	(3)	(12)	(9)	(3)	0	0	(1)	(0)	(0)

1. HONG KONG has not been counted as a Contracting State in making the above totals. The Conventions for which IMCO is depositary are extended to this territory by the United Kingdom Government.

*(a) 1971 (Great Barrier Reef) Amendment

(b) 1971 (Tanks) Amendment

x = Convention or Amendment, ratified, accepted, approved or acceded to, and in force

(x) = Convention or Amendment, ratified, accepted, approved or acceded to, but not yet in force

N.B. Reservations by States have not been indicated

ANNEX 3

IACS UNIFIED REQUIREMENTS

Requirement No.	Title	Year Adopted	Working Group Concerned
1	Requirements for Hull Structural Steels	1959	Hull Structural Steels
2	Rules for the Approval of Electrodes for Manual Arc Welding in Hull Construction	1963	Electrode
3	Rules for the Approval of Wire-Flux Combination for Submerged Arc Welding in Hull Construction	1964	Electrode
4	Equipment Table and Associated Notes	1965	Equipment
5	Tentative Requirements for Chain Cables	1967	Equipment
6	Relief Valves for Cylinders Internal Combustion Engines	1969	Engines
7	Alarm Devices of Internal Combustion Engines	1971	Engines
8	Speed Regulators and Overspeed Devices of Internal Combustion Engines	1971	Engines
9	Parts of Internal Combustion Engines for which Material Tests are Required	1971	Engines
10	Limits of Flash Point of Oil Fuel	1971	Engines
11	Mass Production of Internal Combustion Engines—Procedures for Inspection	1971	Engines
12	Requirements for High Tensile Hull Structural Steels	1971	Hull Structural High Tensile Steels
13	Position and Arrangements of the Collision Bulkhead	1971	Load Lines
14	Extension of the Unified Equipment Table	1971	Mooring and Anchoring
15	Rounding off of Test Load Values for Stud-link Chain Cables	1971	Mooring and Anchoring
16	Requirements for K3 Anchor Chain Cable	1971	Mooring and Anchoring
17	Number of Prefabrication Material Tests for Chain	1971	Mooring and Anchoring
18	Some details of Equipment Number Calculation	1971	Mooring and Anchoring
19	Comparative Testing of High Holding Power Anchors	1971	Mooring and Anchoring
20	Loading Guidance Information	1971	Strength of Ships
21	Cathodic Protection	1971	Tanker Safety
22	Aluminium Paints	1971	Tanker Safety
23	Tank Cleaning Openings	1971	Tanker Safety
24	Steam Temperatures in Pump	1971	Tanker Safety
25	Pump Room Ventilation	1971	Tanker Safety
26	Slop Tanks in Combined Oil/Ore Carriers	1971	Tanker Safety
27	Pump Room Alarms	1971	Tanker Safety
28	Standardisation of Flash Points	1971	Tanker Safety

Requirement No.	Title	Year Adopted	Working Group Concerned
29	Explosimeters and Gas Detectors	1971	Tanker Safety
30	Lighting on Decks	1971	Tanker Safety
31	Pressurisation of Cargo Tanks	1971	Tanker Safety
32	Lighting and Sighting Ports in Pump Room/Engine Room Bulkheads	1971	Tanker Safety
33	Glass Reinforced Plastic (GRP) Hatch Covers	1971	Tanker Safety
34	Acceptable Materials for Tank Cleaning Opening Covers	1971	Tanker Safety
35	Flame Arresters	1971	Tanker Safety
36	Test Pressures for Parts of Internal Combustion Engines	1972	Engines
37	List of Minimum Required Spare Parts for Main Internal Combustion Engines of Ships for Unrestricted Service	1972	Engines
38	List of Minimum Required Spare Parts for Each Type of Auxiliary Internal Combustion Engine Driving Electric Generators for Essential Services on Board Ships for Unrestricted Service	1972	Engines
39	Safety Valves for Crankcases of Internal Combustion Engines	1972	Engines
40	Protection of Internal Combustion Engines against Crankcase Explosions	1972	Engines
41	Protective Devices for Starting Air Mains	1972	Engines
42	Fire Extinguishing Systems for Scavenge Manifolds	1972	Engines
43	Cargo Tank Venting for Petroleum Tankers	1972	Fire Protection/ Tanker Safety
44	Gland Seals in Pump Room Bulkheads	1972	Fire Protection/ Tanker Safety
45	Inert Gas Generating Installations on Vessels Carrying Oil in Bulk	1972	Fire Protection/ Tanker Safety
46	Fixed Tank Washing Machines	1972	Fire Protection/ Tanker Safety
47	Ballasting of Forward Compartment	1972	Fire Protection/ Tanker Safety
48	Arrangements at Cargo Discharge Points	1972	Fire Protection/ Tanker Safety
49	Glass Reinforced Plastic (GRP) Hatch Covers (Revised)	1972	Fire Protection/ Tanker Safety
50	Minimum Requirements for Anchor and Mooring Equipment for Fishing Vessels with a Length of 24 Metres and over	1972	Mooring and Anchoring
51	Equipment for Tugs and Dredgers	1972	Mooring and Anchoring
52	Steel-Cored Wire Ropes	1972	Mooring and Anchoring
53	Definition of "h" in the Equipment Number Calculation	1972	Mooring and Anchoring
54	An Addition to "Requirements for High Tensile Hull Structural Steels"	1972	Materials and Welding
55	Rules for Pipes	1972	Pipes and Pressure Vessels

WP/Engines:—
Requirements 6, 7, 8, 9, 10, 11, 36, 37, 38, 39, 40, 41 and 42

WP/Tanker Safety:—
Requirements 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34 and 35

WP/Fire Protection and Tanker Safety:—
Requirements 43, 44, 45, 46, 47, 48 and 49

WP/Load Lines:—
Requirement 13

WP/Equipment:—
Requirement 4 and 5

WP/Mooring and Anchoring:—
Requirements 14, 15, 16, 17, 18, 19, 50, 51, 52 and 53

WP/Ship Structural Steels:—
Requirement 1

WP/Electrodes:—
Requirements 2 and 3

WP/Hull Structural High Tensile Steels:—
Requirement 12

WP/Materials and Welding :—
Requirement 54

WP/Pipes and Pressure Vessels:—
Requirement 55

WP/Strength of Ships:—
Requirement 20

IACS STATEMENTS

IACS Statement No.	Title	Year Adopted	Working Group Concerned
1	Container Testing, Documentation and Facilitation Procedure	1971	Containers
2	Adjustment of Chain Weights of Stud-link Chain	1971	Mooring and Anchoring
3	Requirement for Mooring Winches	1971	Mooring and Anchoring
4	Locating of Spare Bower Anchor at Points along a Regular Trade Route	1971	Mooring and Anchoring
5	Portable Electrical Equipment	1971	Tanker Safety
6	Oil Navigation Lights	1971	Tanker Safety
7	Corrosion Control	1971	Tanker Safety
8	Container Testing and Facilitation Procedure	1972	Containers
9	Simultaneous Carriage of Ore/Oil	1972	Fire Protection/ Tanker Safety
10	Types of Ships	1972	Load Lines
11	Protection of the Crew	1972	Load Lines
12	Presentation of Stability Information	1972	Load Lines
13	Air Pipes	1972	Load Lines
14	Type of Hatch Cover required if a Lower Deck is Designated as the Freeboard Deck	1972	Load Lines
15	Minimum Bow Height	1972	Load Lines
16	Definition of the Term "Timber Deck Cargo"	1972	Load Lines
17	Interpretation of "Designed to have Empty Compartments"	1972	Load Lines
18	Position of the Vertical Centre of Gravity	1972	Load Lines
19	Guidance Note for Windlasses	1972	Mooring and Anchoring
20	Diameters of Anchor Chain Cables	1972	Mooring and Anchoring
21	Portable Tanks without Pressure Relief Devices	1972	- - - - - - -

WP/Containers:—
Statements 1 and 8

WP/Tanker Safety:—
Statements 5, 6 and 7

WP/Fire Protection/Tanker Safety:—
Statement 9

WP/Load Lines:—
Statements 10, 11, 12, 13, 14, 15, 16, 17 and 18

WP/Mooring and Anchoring:—
Statements 2, 3, 4, 19 and 20

Not Under a Working Party:—
Statement 21

ANNEX 4

Various Bodies granted Consultative Status at IMCO under the Rules Governing Relationship with Non-Governmental International Organisations (Position at October 1971)

International Chamber of Shipping (ICS)
International Organisation for Standardisation (ISO)
International Union of Official Travel Organisations (IUOTO)
International Shipping Federation Limited (ISF)
International Electrotechnical Commission (IEC)
International Union of Marine Insurance (IUMI)
International Chamber of Commerce (ICC)
International Confederation of Free Trade Unions (ICFTU)
International Association of Lighthouse Authorities (IALA)
International Radio-Maritime Committee (CIRM)
International Commission on Illumination (CIE)
World Confederation of Labour (WCL)
Permanent International Association of Navigation Congresses (PIANC)
International Superphosphate Manufacturers' Association Limited (ISMA)
European Nitrogen Producers' Association (APEA)
International Maritime Committee (CMI)
International Association of Ports and Harbors (IAPH)
Baltic and International Maritime Conference (BIMC)

International Association of Classification Societies (IACS)
International Law Association (ILA)
International Cargo Handling Co-ordination Association (ICHCA)
European Council of Chemical Manufacturers' Federations (CEFIC)
European Industrial Space Study Group (EUROSPACE)
Latin American Shipowners' Association (LASA)
Oil Companies International Marine Form (OCIMF)

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Lloyd's Register Technical Association

Discussion

on

Mr. R. P. Harrison's Paper

LLOYD'S REGISTER OF SHIPPING'S RELATIONS WITH IMCO AND IACS

Paper No. 1. Session 1973-74

FOR PRIVATE CIRCULATION AMONGST THE STAFF ONLY

Hon. Sec. C. Cummins
71, Fenchurch Street, London, EC3M 4BS

Discussion on Mr. R. P. Harrison's Paper

LLOYD'S REGISTER OF SHIPPING'S RELATIONS WITH IMCO AND IACS

Mr. F. N. BOYLAN

Mr. Harrison's paper is not one that lends itself to lively discussion because it is basically a factual report on the Society's actual position with reference to IMCO and IACS. There is a lot of information condensed into this short paper, however, and some of the statements made are, perhaps, a little intimidating when the future of the Society is considered. IMCO came into existence only in 1948 and was not ratified until ten years later, which is only 15 years ago, and yet the Resolutions adopted since then, as listed on pages 10 to 19 embrace many aspects of matters affecting classification. When one considers all these items in conjunction with the curve shown in Fig. 6, one is inclined to wonder what will the ultimate end be. The Resolutions already passed total nearly 300. If the curve is correct these will be doubled by 1982 and one receives the impression that they will then cover most aspects of classification.

This trend, coupled with the standardisation which tends to result from the work of IACS, would seem to suggest that classification as we now know it, will no longer exist within the foreseeable future. It is interesting to note, however, that the amount of work in dealing with statutory requirements delegated to the Society has very much increased in the meantime and that International Conventions Department has had to quadruple its staff to deal with this. Presumably this trend will continue although it is hoped that the number of statutory requirements with which a ship must comply will not proliferate in proportion to the total number of IMCO Resolutions.

On page 7, Mr. Harrison stresses the point that the result of the deliberations and Resolutions evolved by IMCO has been to impose a significant increase in work carried out by Classification Societies, but as I have just remarked this increase principally involves Statutory Regulations which are not really the inspiration of a Classification Society and resolutions taken by IMCO will, in effect, also have the force of law on matters affecting design and structural standards. However, there is an inherent weakness in creating legal requirements and passing laws nationally and internationally. It is that such Regulations tend to become inflexible and require new legal procedures before they can be altered whereas the development in the size and types of ships has been, and is likely to be, very swift so that the functions of a really efficient Classification Society, such as Lloyd's Register, which is backed by thoroughly competent staff who are capable of keeping abreast of the required research and development, must always represent a truly valuable and important function in the world of shipbuilding.

With regard to standardisation of requirements, it is significant that, as stated by Mr. Harrison on page 6, the work of IACS is largely devoted to technical matters arising from the proposed work programme of IMCO. This is, of course, true and it is only necessary to think of the forthcoming Convention on Pollution to realise how much work is involved, but it also tends to indicate that the unification of Classification Rules does not progress very rapidly outside the influence of IMCO. I suggest that this must be the case. Classification Societies vary from a few really large and efficient organisations to much smaller national bodies who do not possess the facilities for development and research and it is difficult to visualise how new trends and developments can be handled by IACS as a single unit—which would be necessary before Classification Rules could really be standardised. I would also suggest that it would be very undesirable for such a state of affairs to develop because this would, in effect, mean that the "dead hand" of bureaucracy was being imposed upon a system which has proved its worth to the shipping industry over many years.

It is possible, therefore, that the effect of IMCO and IACS on Lloyd's Register, in years to come, will be that the Society will be employed to an even greater extent in applying statutory rules and regulations for governments and authorities throughout the world and that these will cover much of standard building practices and basic standards of strength, but because there will still remain the necessity for progressive research and development, the Society is likely to become more of a consultative organisation to owners and builders with regard to the design and construction of new types of ships.

Mr. Harrison has presented the construction, organisation and functions of both IMCO and IACS in a very clear manner which will certainly enable Surveyors who are not habitually dealing with either of these bodies to understand them and their relation to the Society much more clearly.

Mr. Harrison also has the responsibility of maintaining a liaison between the Society and the many external bodies on which Lloyd's Register are represented for one reason or another. It might be surprising to some to know that there are at present over 120 conferences, committees, etc., in which Lloyd's Register are engaged and these require attendance by several Surveyors almost every week. Inevitably, unless there is some control and correlation between all the persons involved, a good deal of overlapping could result. Mr. Harrison's efforts are directed towards keeping the number of enforced absences from the direct work of the Society by Surveyors from the many different departments, to an efficient minimum.

It is, of course, highly desirable that the Society should be represented on many of the bodies which are concerned in formulating rules and regulations, or in developing new procedures or standardising practices, etc., but it will be agreed that time should not be lost unnecessarily by overlapping or duplication. Therefore, I would suggest that before fresh representation on any external body is agreed upon, each case should be carefully judged on its own merits from the point of view of the Society's interests. This paper has to some extent drawn attention to this problem and for this we have to thank Mr. Harrison.

Mr. R. C. HUTCHINSON

First case I should like to add my congratulations and thanks to Mr. Harrison for an informative paper.

Just inside the cover in the middle of the page there is a small paragraph, and I should like to shelter under the umbrella provided by the second sentence of that paragraph. I am fully qualified to rush in where more celestial ceatures might hesitate.

Mr. Harrison has been *very* diplomatic in this paper and this I can understand, because although in theory staff association papers are limited to Lloyd's Register staff, they *do* fall into the hands of outsiders. To quote but one instance, reference is made to some National Authorities not having available the necessary technical skills or resources. This shortage does not, however, prevent them from expressing opinions and in some cases one could even describe it as campaigning. I sometimes suspect, however, that the stones they throw are not of their own manufacture.

My own opinion is that IMCO is going into such great detail now, that in the not too distant future Classification Rules will, for the main part, only be an elaboration of IMCO requirements which will, of course, be statutory requirements. It is for this reason that I feel the Society must make every endeavour to participate fully in the formulation of IMCO requirements.

Figure 1 shows the organisation of IMCO and whilst this is very informative it does not tell the full story.

At the top of the table is the U.N., this is, of course, 100 per cent political. At the bottom we have *ad hoc* working groups. These are for the main part technical but the change over from political to technical is not a gradual and smooth line. I would say that the political aspect is dominant down to committee level and is still very strong even in sub-committees.

At sub-committee level an IACS representative will, in general, be listened to politely, at committee level he will probably not even be given the opportunity to speak. Whilst this may be frustrating and harmful to the blood pressure of observers at IMCO meetings, it does not really matter provided we take full advantage of the manner in which IMCO works. In any case it is too late to change much at sub-committee or committee level.

Each stage of IMCO works on the reports submitted to it by the stage below. *Ad hoc* groups report to sub-committees and sub-committees report to the Safety Committee and so on.

My opinion, therefore, is that we should ensure always that the Society is adequately represented on all *ad hoc* working groups, because in these groups one can have his full say and will be listened to and it is here that, to a very large extent, the Regulations are formulated.

Furthermore, although not shown on the table there is a stage below the IMCO working groups. The IMCO groups use as a basis papers submitted by National Authorities, etc. In this country we have for example the D.T.I. and the Chamber of Shipping submitting papers drawn up by their own working groups and we should make every effort to ensure that we particpate in these working groups.

If we do not play our full part in both the IMCO and these other working groups we will find, and this is already happening, that we will have to apply requirements with which we are not in agreement.

One other point on IMCO, I would appeal to all participants in working groups. Don't try to do it all yourself or keep it secret. If the subject to be discussed is normally dealt with in whole or in part by another department within the Society, let that department know in good time so that proper briefing and, if necessary support, can be offered at the working group by someone more familiar with the subject.

In conclusion, I would like to add just a word on the subject of IACS. I would very much like to see some arrangement to ensure that IACS unified requirements are simultaneously applied by all members. Unified interpretations could, of course, present more problems.

Mr. J. M. Bates

There is no doubt that colleagues everywhere know the meaning of the initials IMCO and IACS, but a full understanding of the activities of the organisations they represent, their inter-relationship and its effect on the Society are probably less widely spread. Mr. Harrison's paper is, therefore, valuable in this respect.

It may not be out of place to mention that in spite of its far reaching activities in the study of problems affecting the safety of ships, their crews, passegers and cargoes, and also of problems affecting the environment, IMCO has no real power to enforce the recommendations, codes or conventions which are the end product of its deliberations. Such power, quite properly, remains vested in the governments of the countries concerned.

Non-membership of the IMCO Convention does not preclude countries from participating in conferences promoted by IMCO or from ratifying the consequent Conventions.

Whereas the growth rate of Resolutions adopted by IMCO appears to be spectacular according to the curve shown in Fig. VI of the paper, it should be noted that out of 258 such Resolutions only about 60 have a content which has a direct or indirect impact on the Society's activities from the classification or statutory points of view. If this were to be taken into account, Fig. VI would no doubt, look less forbidding. Such Resolutions may refer to Conventions, Codes or Recommendations; the Author's explanation of the international rating or effect of the last two would be appreciated as their unilateral application often gives rise to uncertainty and confusion.

Mr. Harrison states clearly the reasons which led to the formation of IACS. Its recognition by IMCO as a non-governmental organisation is of undoubted advantage in enabling the members of the Association to follow closely the development of international regulations affecting the safety of ships and of the environment. The role of IACS at IMCO is, however, limited to the status of an observer with no voting power or rights. Its influence is effective only within the *ad hoc* or Working Groups which are subsidiaries to the various Sub-Committees. IACS participation in the discussions of a Sub-Committee is entirely dependent on the good will of its Chairman. As Mr. Hutchinson has already said there is little doubt that the main effort of IACS must be concentrated within the Working Groups at IMCO and through national administrations outside IMCO.

IACS now has nine members and one associate member. In my own experience as a member of the Working Party on Load Lines, I have found its meetings to be conducted in an atmosphere of real co-operation and good will which may have resulted from the international character of the majority of the Societies represented and the manageable size of the Working Party. It is likely, however, that other Classification Societies of a primarily national character will seek membership of IACS. It remains to be seen whether an increased membership, bringing with it unwieldy working parties, will achieve the same rewarding results.

The Classification Societies on whom falls the burden of applying international conventions are often faced with the problem of interpreting loosely-framed regulations. It must be evident that competition between Societies on this account is not tolerable and that a common approach is essential. Such

a situation arose immediately after the International Conference on Load Lines 1966, when a Working Party on Load Lines was constituted from six Societies, well before the creation of IACS. The formulation of uniform interpretations of regulations is one of the essential tasks of IACS and it is regrettable therefore that the Author has omitted from the list of unified requirements in Annex 3 of his paper, the 35 unified interpretations of the 1966 Load Line Convention which were agreed by the Working Party, not to mention those which have already been accepted as IMCO recommendations, or those about to be published. The interpretations referred to are now on the agenda for the IMCO Sub-Committee on Subdivision and Stability for discussion and possible universal acceptance.

The Author mentions on page 6 that the Society is always pleased to entertain requests from national administrations to provide delegates at IMCO or technical advisers at or outside IMCO. Whereas it may be gratifying to the Society to receive such requests, it would be impracticable to undertake too many commitments of this nature. As an example, the International Conventions Department has to make available nine members of its staff to participate in meetings of various working parties for IACS, the United Kingdom Chamber of Shipping, the International Chamber of Shipping and other specialist groups and to attend IMCO meetings as delegates or advisers to the delegation of the United Kingdom, Liberia and IACS. These commitments are not confined to attendance at meetings as much time must perforce be spent to deal with correspondence and preparations between meetings. Other staff has also to be made available when special investigations, which can be lengthy, require to be undertaken.

Fig. V shows clearly the channels through which the Society can convey its views and experience to IMCO, but the L.R. pincer, although not to be underestimated, is not so formidable nor the IMCO nut so small as the diagram might suggest.

In conclusion, and to use "modern" language, it is certain that the Society through IACS has a place in the IMCO ecology in an environment which is no longer hostile, if it ever was. The growth of international regulations notably those looming ahead in the immediate future such as the 1969 Tonnage Convention, the Marine Pollution Convention 1973 which will incorporate various Codes and recommendations already adopted, the revision of SOLAS in 1974, the Conference on Fishing Vessels, etc., will place demands on Administrations for inspections, surveys and certification which many will not be able to satisfy. It is probable that even some of the major Administrations will find it convenient to delegate a good deal of the work to Classification Societies and transfer to them the problem of finding staff which is adequate both in number and quality.

Mr. T. R. FARRELL

With reference to the statement on page 1 concerning "the highest practicable standards for ensuring maritime safety and efficiency of navigation", perhaps the Author would indicate whether or not there is concern within IMCO, or any associated bodies, that a point of diminishing returns may be reached, i.e. that the continuing increase in volume and complexity of resolutions, leading ultimately to related national or classification requirements, may result in such uncertainty (or even confusion) amongst Owners and operators that the high standards referred to above may not be achieved. It seems that this possibility necessitates a constant awareness of "where the IMCO train is going", and continuous evaluation of results. In this context, it is noted that during the year ended 31st December, 1971, the total tonnage lost reached a record high level, exceeding one million tons for the first time (ref. L.R. Statistical Tables, November 1972).

On the more practical level, it would be appreciated if the Author would indicate how technical problems are raised and processed at IMCO.

Mr. A. K. BUCKLE

Having suffered from not knowing the codes when I first got involved in international work, may I plead on behalf of my fellows for a few explanations.

In Fig. IV reference is made to "Binding" and "Liaison" relationships. Most people will have no idea of the difference. Similarly few outport surveyors are likely to be aware of the different responsibilities of E.C.E. and the E.E.C., of the connection of the E.E.C. and C.E.N., or of GRUNDT and A.D.N.R. A short appendix defining these initials would be helpful.

On page 5, column 1, reference is made to IACS requirements being ratified. For how long is ratification supposed to be applicable? My experience is that certain societies are prone to change "ratified" rules two or three years later and the IACS Council is powerless or unwilling to prevent them doing so.

I do not agree with the remark that it is regrettable that L.R. is precluded from direct involvement in IMCO. I am glad that this exclusion allows the Society to take technical decisions without the need for one eye to be kept on political pressures being applied to achieve ends in other fields. Economic restraints are enough to keep one fully alert to the surrounding world's existence.

Someone once said that there are lies, dam lies and statistics. Fig. VI illustrates the point. If we delete resolutions relating to IMCO housekeeping matters, like pensions and credentials, and then plot the resulting resolutions as steps, one finds that instead of exponential trend we get a straight line with it's zero at 1961. So what? Virtually all the Society's work in fact derives from only about a dozen resolutions. It is content that matters, not numbers.

Finally, I agree with the other contributors that the only effective point to significantly influence IMCO is in the *ad hoc* working groups. Even here no results are likely unless IACS can generate and submit papers before the the meetings take place. The agenda for such meetings is so tight and so well organised that a written paper is essential if proper consideration of any matter is to be achieved. If a written paper is submitted, however, proper consideration is virtually guaranteed. The moral is obvious!

AUTHOR'S REPLY

To Mr. Boylan

The Author is indebted to Mr. Boylan for initiating discussion on the paper and for the many apt observations relating to the effects of the two Organisations, IMCO and IACS. It is, in addition, reassuring to find that the opinions he expresses accord, generally, with those given in the paper.

Mr. Boylan has, by his opening remarks, appreciated that the paper was deliberately written in a factual manner, since it was intended for the guidance of colleagues unfamaliar with the workings of IMCO and IACS rather than a vehicle for the conveyance of any new or revolutionary concepts. Apart from the attempt to "peek" into the future there is little that can provide fuel for really heated debate!

An exception is, perhaps, the curve in Fig. VI depicting Resolutions adopted by IMCO since that Organisation became operational. This graph has been referred to by Mr. Boylan and by subsequent speakers who have questioned its validity, particularly in respect of direct implications for the Society. It has been correctly pointed out by these speakers that a considerable number of the Resolutions involved concern IMCO administrative matters only and are thereby outside the activities of Lloyd's Register of Shipping. The information presented in Fig. VI is not, perhaps, so misleading or controversial as it would appear from the queries raised. The points or values for the curve are indisputable and the graph was included to illustrate increasing activity within IMCO based on the "end product" of the Organisation, namely resolutions. It can then be anticipated that some proportion of the increasing total activity of IMCO will, no doubt, impinge on the work of the Society.

The paper did, in fact, contain a warning implying that with the adoption of a single resolution by IMCO, an international conference can be convened from which a volume of technical regulations, of interest to the Society, may be included in the resulting convention. It regrettably remains true, that the actual contents of IMCO resolutions vary. However, the Author considers no vindication is required for the inclusion of Fig. VI. The adoption of a further 56 resolutions by the IMCO Assembly in November, 1973, confirms the acceptable level of accuracy for the first predicted point on the curve.

In common with Mr. Boylan, the Author certainly acknowledges the pressure being exerted from various sources such as, shipbuilders associations, ISO, IEC, IACS, etc., all directed towards standardisation, which it is considered will, when combined with the incorporation of IMCO resolutions into national or international legislation, radically alter classification as it is now known. The steps recently contemplated by the Department of Trade and Industry for the United Kingdom do to some extent follow predictions ventured on page 8. There is little reason to doubt, if reason be pursued, that implementation should ultimately follow and be emulated, in due course, by other national administrations. The International Conference on Marine Pollution (1973) and the resulting International Convention for the Prevention of Pollution from Ships (1973) serve to portray the increase in statutory certification which can, in future, be expected.

The unfortunate and inherent inflexibility of statutory regulations embodying technical requirements, together with difficulties arising from attempts to standardise classification rules, are highlighted by Mr. Boylan. In connection with the former, it can be reiterated that a solution lies in having IMCO codes and conventions to define broad technical principles only, thus permitting vital details to be developed by the classification societies in step with technological progress. In the matter of standardisation of classification rules, the Author is convinced such rules should only be accepted by the Society when there exists complete satisfaction on their technical validity and safety aspects.

Mr. Boylan, in concluding his remarks, directs attention to the necessity to watch and carefully control the extent to which the Society's technical staff are committed to various external activities, which from the aspect of overall operational efficiency, it must certainly be agreed, does require to be maintained at an effective minimum.

To Mr. Hutchinson

In expressing thanks for the kind sentiments contained in the contribution, the Author also welcomes certain other views offered by Mr. Hutchinson since they carry a relevance emanating from his considerable experience in various IMCO and IACS committees.

The view that some delegations attending IMCO, not necessarily technically prominent, inject into the proceedings political issues not of their own manufacture and having few direct links with their countries, was rather substantiated at the recent Assembly meetings. At these particular meetings, other delegations protested against these manœuvres by pointing out that IMCO is essentially a technical agency and an inappropriate forum for debating political matters which could, more effectively, be done at the United Nations. Regrettably this is a trend which has become more apparent with the increasing membership of IMCO and is one which may prove difficult to eliminate, particularly at conferences and meetings of the Assembly.

The Author shares Mr. Hutchinson's fears that IMCO is tending towards the embodiment of too much detail in its technical recommendations, a fear which prompted the views expressed on page 8. It must therefore be agreed that the Society's representatives should certainly play an active part in the lower echelons of IMCO workings, an area where the technical content of eventual resolutions is thrashed out. These representatives must also, as Mr. Hutchinson suggests, as far as practicable, become involved with other bodies dealing with technical matters of interest to the Society, prior to such matters being introduced into deliberations at IMCO.

The point made by Mr. Hutchinson, on the vital necessity for close co-operation between the Society's participation at IMCO and the appropriate departments or colleagues at Headquarters, cannot be over-emphasised and the Author must strongly support and even reinforce this opinion.

Mr. Hutchinson's final remarks regarding the simultaneous implementation by members of IACS unified requirements merits attention, however, as circulation of this discussion is restricted to members of the Society, one hesitates to "preach to the converted". It is considered that such matters, which have associated economic considerations, should as required, be raised solely within the concerned working party or council of IACS.

To Mr. Bates

Thanks are due to Mr. Bates for directing attention to two

features of IMCO work which have not been fully developed in the paper.

To deal with the first point, it can be noted that the functions of the Organisation IMCO as prescribed under the terms of the Convention (Ref. page 1, column 1) do not permit IMCO to enforce any of the recommendations or requirements contained in Resolutions, Codes or Conventions; such enforcement always resting with the appropriate authorities of the concerned State.

The second point to be noted is that, States not subscribing to the IMCO Convention are, in fact, able to participate in the International Conferences convened by IMCO. They can subsequently ratify, accept, accede to, etc., the evolved conventions. In this connection, caution must be observed in respect to States which may be the subject of special U.N. Resolutions.

The two foregoing issues concerning IMCO procedure are important, they should be heeded since they appear to be widely misunderstood.

The matter of the graph in Fig. VI has been dealt with in the reply to Mr. Boylan and does not now require further comment.

In so far as the international rating or effect of IMCO codes or recommendations are concerned, it is considered there will be little effect on the shipping industry until such time as necessary legislation is enacted by individual governments for enforcement, or alternatively such recommendations become mandatory through inclusion in an International Convention's entering into force in a prescribed manner. The Owners of a proposed newbuilding may, however, in anticipation of impending national legislation or international convention entering into force, specify their ships be constructed in conformity with certain IMCO Codes or Recommendations. In such circumstances contractual obligations may be placed upon the builders and, possibly, the Society could also be involved in such cases.

The experience of Mr. Bates in the WP/LL appears to reflect the impressions gained by other members of the Society's staff attending the various working parties of the Association. The Author, while awaiting with interest the outcome of any possible increase in the size of working parties resulting from an enlarged IACS, does have reservations on possible advantages to the Society of such a development.

Mr. Bates has been closely associated with the considerable task carried by the IACS WP/LL in the unification of interpretations for the 1966 Load Line Convention. It is regretted that details of the 35 Unified Interpretations developed, were not included as an appendix in the paper. It is, however, hoped that by circulating them as an appendix to the discussion, some amends for this oversight will be achieved.

It is believed that a certain satisfaction must accrue to the members of the Working Party on Load Lines, since the unified interpretations of IACS have now been included as an Agenda item for discussion within IMCO, which could lead, thereafter, to their possible universal acceptance.

On the matter of the Society's staff possibly representing National Authorities at IMCO it is felt that Mr. Bates has to some extent considered only the commitments of his own department. It was for the reasons outlined, that the word "entertain" was after some thought chosen and used in the paper (page 6). Approaching the problem in this manner permits consideration of the actual needs of the particular administration concerned, L.R. staffing requirements, together with long and short term interests to the Society, etc., to be fully weighed before a final decision is reached. Despite such considerations influencing individual cases, the Author remains of the opinion that the increasing importance of statutory work dictates that the Society should, whenever possible, render all the possible assistance to National Authorities.

It is thought Mr. Bates must agree with this viewpoint, just as the Author is in full sympathy with his closing remarks.

To Mr. Farrell

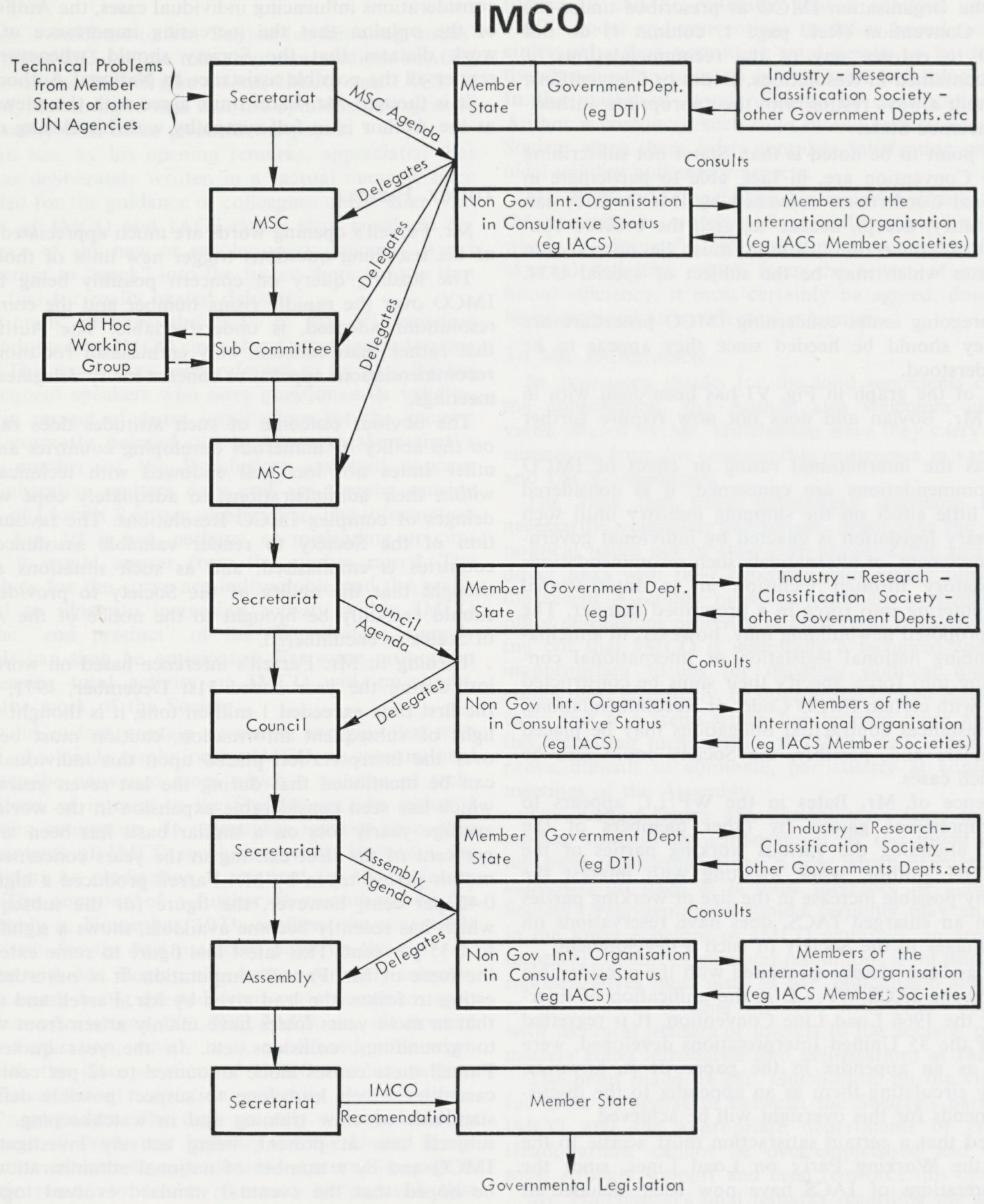
Mr. Farrell's opening words are much appreciated and some of his searching questions trigger new lines of thought.

The leading query on concern possibly being felt within IMCO over the rapidly rising number and the complexity of resolutions adopted, is understandable. The Author regrets that rather than concern, only enthusiasm for more detailed recommendations appears to concern many delegates to IMCO meetings.

The obvious outcome of such attitudes does raise doubts on the ability of numerous developing countries and perhaps other states not too well endowed with technical strength within their administrations, to adequately cope with future deluges of complex IMCO Resolutions. The favourable position of the Society to render valuable assistance to these countries is emphasised, and as such situations arise, it is thought that the ability of the Society to provide this help should certainly be brought to the notice of the Authorities of States so encumbered.

Turning to Mr. Farrell's inference based on world tonnage lost during the year ended 31st December, 1971, which for the first time exceeded 1 million tons, it is thought that in the light of subsequent information, caution must be exercised over the interpretation placed upon this individual figure. It can be mentioned that during the last seven years, a period which has seen considerable expansion in the world fleet, the average yearly loss on a similar basis has been around 0·39 per cent of the fleet existing in the years concerned. The 12-month period taken by Mr. Farrell produced a higher loss of 0·42 per cent, however, the figure for the subsequent year, which has recently become available, shows a significant drop to 0·35 per cent. This latest loss figure to some extent reduces the force of Mr. Farrell's imputation. It is, nevertheless, interesting to follow the lead given by Mr. Farrell and to discover that in most years losses have mainly arisen from wrecks due to groundings, collisions, etc. In the year quoted by Mr. Farrell these causes alone amounted to 42 per cent of all the casualties which leads one to suspect possible deficiences in standards of crew training and in watchkeeping. These two subjects are, at present, being actively investigated within IMCO and by a number of national administrations. It is to be hoped that the eventual standard evolved together with other measures already dealt with by IMCO, such as traffic separation schemes, should contribute to the safer navigation of ships in future years.

It is rumoured in some circles that no worthwhile organisation or department should be without a "flow-chart" and Mr. Farrell's final question on the manner in which technical problems are raised and processed by IMCO permits one to indulge in this current trend. It is hoped that the following chart provides a satisfactory reply to this pertinent enquiry.



N.B.—The newly formed MEPC will in certain cases take the place of the MSC in the diagram.

FIG. D 1

To Mr. Buckle

A number of the issues raised by Mr. Buckle cause the Author to reflect, who for this reason alone is grateful, since any further points developed must be of benefit to future readers. Dealing with the various matters in the order in which they were raised, it is hoped that the following will provide the necessary information or explanations which Mr. Buckle seeks.

In Fig. IV the essential difference between a "Binding" and a "Liaison" relationship may be dealt with by indicating that the former applies only between IMCO and IACS where the relationship is bound by the recognition afforded under the IMCO Rules governing relationship with non-governmental international organisations, rules which permit of some reciprocal rights. On the other hand, "Liaison" relationship, applies to contacts with other organisations, established for occasional exchanges of views where reciprocal rights are not required.

In response to Mr. Buckle's request for a short list of abbreviations it is again hoped that the following will be useful although it is by no means a comprehensive list.

UNO	United Nations Organisation
UNCTAD	United Nations Conference on Trade & Development
UNIDO	United Nations Industrial Development Organisation
UNESCO	United Nations Educational Scientific & Cultural Organisation
UNDP	United Nations Development Programme
ECE	Economic Commission for Europe (under UNESCO)
EEC	European Economic Community (Common Market)
GRUNDT (ECE)	Group of Experts on Standardisation of Technical Requirements for Vessels and of Ships' Papers
ADNR	Regulations for the Carriage of Dangerous Substances on the Rhine
ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
CEN	European Committee for Standardisation
ILO	International Labour Organisation
FAO	Food and Agricultural Organisation of the UN
WHO	World Health Organisation
ICS	Internation Chamber of Shipping
ISO	International Organisation for Standardisation
OCIMF	Oil Companies International Marine Forum

Mr. Buckle's association with the Rule Development department, no doubt, accounts for the vigilance in observing changes to the Rules of other Societies. On the particular issue which he raises, it is not possible to provide well defined guidelines. It is, however, considered that when it can be positively established that an IACS unified requirement, which has been incorporated into the Rules of a member society, is, without notice being circulated, dropped from those Rules, then the member societies should take up the matter within the Association. This may be done either within the working parties concerned with the particular rule or at IACS Council meetings.

It is unnecessary to answer remarks on Fig. VI since these have been dealt with in reply to Mr. Boylan.

A parallel can be drawn from the comments of Mr. Hutchinson and Mr. Buckle, concerning the effectiveness of work within the *ad hoc* working groups and sub-committees of IMCO, and the Author would agree with both colleagues on this score.

AMENDMENTS

The extent to which discussion has surprisingly been evoked from colleagues is indeed pleasing since, in essence, the paper was originally written and intended for reference purposes. The Author therefore greatly appreciates the compliments and various comments made and would warmly thank all contributing to the discussion on the paper.

At this juncture attention is drawn to additional remarks made at the time the paper was presented which do not appear in the text. These remarks concerned the significant changes necessary to the text and annexes, which result from the continuing work within IMCO and IACS which has taken place since the paper was submitted for printing.

Amendments, as follows, should therefore be made in order to up date the paper to 31st December, 1973. The amendments also correct one or two typographical errors which appear in the text of the paper.

Page 1, col. 1, para. 2, line 1 "Organisation" to read "Organisations".

Page 1, col. 1, para. 3, line 4 Amend 77 to 84 countries (December 1973).

Page 1, col. 2, para. 2, line 5 Amend 77 to to 84 countries.

Page 1, col. 2, para. 7 Amended by IACS Council (May 1973) should read.

"The purpose of the International Association of Classification Societies (IACS) is to co-operate closely and actively with the marine industries of the world and to provide for consultation and co-operation with relevant national and international maritime organisations. Each Member Society is to provide the aims which the Association holds in common."

Page 2, Fig. 1 A new organ should be added ranking equally with the Maritime Safety Committee (MSC) which will carry the title Marine Environment Protection Committee (MEPC) and will appoint, as necessary, sub-committees and *ad hoc* working groups. The duties of the MSC sub-committee Marine Pollution will be absorbed by the (MEPC) and as a result this particular sub-committee now ceases to exist.

Page 3, Fig. II Some re-organisation will be necessary to accommodate the newly created Marine Enviroment Protection Committee but, as yet, this Committee has not met and details are not available.

Page 4, Fig. III Add the undernoted to the given table.

- ● The Protocol on Space Requirements for Special Trade Passenger Ships, 1973.
- ● The International Convention for the Prevention of Pollution from Ships, 1973.
- ● The Protocol relating to Intervention on the High Seas in cases of Marine Pollution by Substances other than Oil, 1973.

The black dot preceding the above indicates they are "not yet in force" and should appear before these words at the foot of the table. The dot should be deleted in respect of the Special Trade Passenger Ships Agreement, 1971 ("Simla Agreement") as this agreement enters into force on 2nd January, 1974.

Page 5, Fig. IV As a result of the IACS Council Meeting in May 1973 a new subsidiary body was appointed. This was the Working Party on Drilling Units with ABS acting as Secretariat.

At the same meeting the following changes in Secretariats were approved.

WP Load Lines Secretariat now GL (prev. DnV)

WP Strength of Ships Secretariat now DnV (prev. GL)

WP Materials & Welding Secretariat now ABS (prev. NK)

WP Containers Secretariat NK (prev. ABS)

CG Electricity Secretariat now NK (prev. ABS)

Page 6, col. 2, para. 1, line 3 Amend "nine" to "ten".

Page 9, col. 2, para. 1, line 4 Correct "stautory" to "statutory".

Page 9, col. 2, para. 4, line 1 Correct "Societies" to "Society's".

Page 18, Annex I Add Resolutions adopted by IMCO Assembly 1973.

Resolution* No.	Title	Date Adopted
A.259(VIII)	Convention on the International Regulations for Preventing Collisions at Sea, 1972	13 Nov 1973
A.260(VIII)	International Convention for Safe Containers (CSC), 1972	13 Nov 1973
A.261(VIII)	International Conference on Space Requirements for Special Trade Passenger Ships, 1973	13 Nov 1973
A.262(VIII)	Approval of Appointment of the Secretary-General by the Council	14 Nov 1973
A.263(VIII)	Amendments to Chapters II, III, IV and V of the International Convention for the Safety of Life ot Sea, 1960	20 Nov 1973
A.264(VIII)	Amendment to Chapter VI of the International Convention for the Safety of Life at Sea, 1960	20 Nov 1973
A.265(VIII)	Regulations on Subdivisions and Stability of Passenger Ships as an equivalent to Part B of Chapter II of the International Convention for the Safety of Life at Sea, 1960	20 Nov 1973
A.266(VIII)	Recommendation on a Standard Method for Establishing Compliance with the Requirements for Cross-Flooding Arrangements in Passenger Ships	20 Nov 1973
A.267(VIII)	Code of Practice Concerning the Accuracy of Stability Information for Fishing Vessels	20 Nov 1973
A.268(VIII)	Amendments to Recommendation on Intact Stability of Fishing Vessels—Appendix V—Recommended Practice on Portable Fish-hold Divisions	20 Nov 1973
A.269(VIII)	Recommendation for Skippers of Fishing Vessels on Ensuring a Vessel's Endurance in Conditions of Ice Formation	20 Nov 1973
A.270(VIII)	Recommendation on Test Method for Qualifying Marine Construction Materials as Non-Combustible	20 Nov 1973
A.271(VIII)	Recommendation to put Fire Safety Measures for Tankers and Combination Carriers into Effect	20 Nov 1973

Resolution* No.	Title	Date Adopted
A.272(VIII)	Recommendation on Safe Access to and Working in Large Tanks and Recommendation on Safe Access to and Working in Large Cargo Holds of Bulk Carriers	20 Nov 1973
A.273(VIII)	Recommendation on Survey of Inflatable Life-rafts	20 Nov 1973
A.274(VIII)	Recommendation on Retro-Reflective Tapes on Life-Saving Appliances	20 Nov 1973
A.275(VIII)	Recommendation on Performance Standards for Mechanical Pilot Hoists	20 Nov 1973
A.276(VIII)	Recommendation on the Number of Persons allowed on Board Existing Passenger Ships Resulting from an Increase in Life-raft Capacity	20 Nov 1973
A.277(VIII)	Recommendation on Performance Standards for Radar Reflectors	20 Nov 1973
A.278(VIII)	Supplement to the Recommendation on Performance Standards for Navigational Radar Equipment (Resolution A.222(VII)	20 Nov 1973
A.279(VIII)	Recommendations on Emergency Position-Indicating Radio Beacons	20 Nov 1973
A.280(VIII)	Recommendation on Performance Standards for Gyro Compasses	20 Nov 1973
A.281(VIII)	Recommendation on General Requirements for Electronic Navigational Aids	20 Nov 1973
A.282(VIII)	Recommendation on the Installation and Use of Manœuvring Lights	20 Nov 1973
A.283(VIII)	Recommendation on the Development of the Maritime Distress System	20 Nov 1973
A.284(VIII)	Routeing Systems	20 Nov 1973
A.285(VIII)	Recommendation on Basic Principles and Operational Guidance Relating to Navigational Watchkeeping	20 Nov 1973
A.286(VIII)	Recommendation on Training and Qualifications of Officers and Crews of Ships carrying Hazardous or Noxious Chemicals in Bulk	20 Nov 1973
A.287(VIII)	Code of Safe Practice for Ships Carrying Timber Deck Cargoes	20 Nov 1973
A.288(VIII)	Recommendation on the Safe Stowage and Securing of Containers on Deck of Vessels which are not specially designed and fitted for the purpose of carrying Containers	20 Nov 1973
A.289(VIII)	Recommendation on Safe Practice on Dangerous Goods in Ports and Harbours	20 Nov 1973
A.290(VIII)	Adoption of the Reports of the Maritime Safety Committee	20 Nov 1973
A.291(VIII)	Arrears of Contributions	20 Nov 1973
A.292(VIII)	Arrears of Contributions—Working Capital Fund	20 Nov 1973
A.293(VIII)	Amendment Procedures for Conventions of which IMCO is Depositary	20 Nov 1973
A.294(VIII)	Voting Rights on Proposed Amendments to Conventions of which IMCO is Depositary	20 Nov 1973
A.295(VIII)	Appreciation of the Services of Mr. Colin Goad to the Organization	22 Nov 1973
A.296(VIII)	International Conference on Marine Pollution, 1973	23 Nov 1973
A.297(VIII)	Establishment of a Marine Environment Protection Committee	23 Nov 1973
A.298(VIII)	Facilitation Measures in Maritime Travel and Transport	23 Nov 1973
A.299(VIII)	Classification and Labelling of Dangerous or Hazardous Cargo	23 Nov 1973
A.300(VIII)	Presentation of the Final Accounts and Audit Report for the Sixth Financial Period	23 Nov 1973

Resolution* No.	Title	Date Adopted
A.301(VIII)	Amendments to the Financial Regulations	23 Nov 1973
A.302(VIII)	Supplementary Estimates for 1973	23 Nov 1973
A.303(VIII)	Long-term Work Programme of the Organization	23 Nov 1973
A.304(VIII)	International Conference on Safety of Life at Sea, 1974	23 Nov 1973
A.305(VIII)	International Conference on the Establishment of an International Maritime Satellite System	23 Nov 1973
A.306(VIII)	Work Programme and Budget for the Eighth Financial Period 1974/5	23 Nov 1973
A.307(VIII)	Printing Fund	23 Nov 1973
A.308(VIII)	Headquarters Facilities and Accommodation	23 Nov 1973
A.309(VIII)	International Civil Service Commission	23 Nov 1973
A.310(VIII)	Exclusion of the Governments of Portugal and South Africa from the Assembly and all Conferences and Meetings of IMCO	23 Nov 1973
A.311(VIII)	Safety of Maritime Navigation	23 Nov 1973
A.312(VIII)	Relations with Non-Governmental International Organizations	23 Nov 1973
A.313(VIII)	Continuation of the Joint Inspection Unit	23 Nov 1973
A.314(VIII)	Convening of an Extraordinary Session of the Assembly	23 Nov 1973

Page 19, Annex 2 Amend (as at 31st December, 1972) to (as at 31st December, 1973).

NOTE.—"This Agreement is not yet in force" appearing in respect of the Special Trade Passenger Ships Agreement, 1971, will shortly require alteration since the Agreement actually enters into force on 2nd January, 1974.

Add:—

— the Protocol on Space Requirements for Special Trade Passenger Ships, 1973. This Protocol is not yet in force.

— the International Convention for the Prevention of Pollution from Ships, 1973. This Convention is not yet in force.

— the Protocol relating to Intervention on the High Seas in cases of Marine Pollution by Substances other than Oil, 1973. This Protocol is not yet in force.

Page 20 The Consolidated List of States showing their Status in Respect of the IMCO Convention and the Conventions or other Instruments deposited with IMCO (to 31st December, 1972).
In order to up date this list to 31st December, 1973, the following amendments require to be incorporated.

IMCO Convention Add: China, Cyprus, Democratic Republic of Germany, Iraq, Jordan, Sierra Leone, Thailand and Zaire.

1960 SOLAS Add: China, Gabon and Libyan Arab Republic.

Amendment 1960 Add: Czechoslovakia.

1967 Add: Czechoslovakia, Netherlands, Switzerland and Yugoslavia.

1968 Add: Czechoslovakia, Israel, Netherlands, Switzerland and Yugoslavia.

1969 Add: Czechoslovakia, Israel, Netherlands, Viet Nam, and Yugoslavia.

1971 Add: Brazil, France, Lebanon, Norway, and United States of America.

1954/62 Oil Pol. Add: Tunisia.

Amendment 1971 Add: Australia, Belgium, Philippines, Tunisia, and United States of America.

1971 (a) and (b) Add: Philippines & Tunisia.

1965 Fal Add: New Zealand and Spain.

Amendment 1969 Add: Australia, Belgium, Philippines, four divisions (a), (b), (c) and (d) covering the aspects stated and accepted by the States as indicated.

(a) Cruises and Cruise Passengers.
In addition to the 16 States already shown in the List as having accepted the Amendment 1971 add Ivory Coast, Nigeria, Poland and Czechslovakia.

(b) Passengers in Transit and Ships in Scientific Services.
Belgium, Canada, Denmark, Finland, Fed. Republic of Germany, Ghana, Ireland, Netherlands, Norway, Poland, Sweden, United Kingdom and United States of America.

(c) Cargo Handling Equipment.
Greece and Fed. Republic of Germany.

(d) Shore Leave for Crew members.
(None).

1966 Load Lines Add: China, Dominican Republic, Hungary and Iran.

Amendment 1971 Add: Lebanon, Greece, Netherlands, Norway, Philippines, Switzerland, Tunisia and United States of America.

1969 Tonnage Add: Finland, Iran and Ghana.

1969 Public Law Add: Sweden and Spain.

1969 Private Law Add: Ivory Coast.

1971 Simla Add: Indonesia, Norway and Philippines.

1971 Nuclear Add: France.

1972 Colregs Add: Ghana, Liberia, USSR and India.

N.B.—The totals given at the foot of each column will require amendment to accord with the foregoing.

Page 28, Annex 4 Add the following to the list:—

International Shipowners Association (INSA).
International Maritime Pilots Association (IMPA).
Universal Federation of Travel Agents Association (UFTAA).
European Tug Owners Association (ETA).
International Air Transport Association (IATA).
Engineering Committee on Oceanic Research (ECOR).
Eurosat S.A.
Friends of the Earth (FOE).

APPENDIX

IACS UNIFIED INTERPRETATIONS OF THE INTERNATIONAL CONVENTION ON LOAD LINES, 1966

NOTE:—IACS Interpretations are to be used only when applying Load Line Regulations on behalf of a particular Administration which has not adopted its own interpretation. Interpretations adopted by Administrations would be respected.

The following Interpretations were submitted to the Governments concerned and IMCO in June 1952.

Interpretation Number	Title	Adopted in	Reference
LL. 1	Application	1968	Article 4(4)
LL. 2	Depth for Freeboard	„	Reg. 3(6)
LL. 3	Superstructure	„	Reg. 3(10)(b)
LL. 4	Details of Marking	„	Reg. 8
LL. 5	Doors	„	Reg. 12
LL. 6	Hatchways closed by weathertight covers of steel or other equivalent material fitted with gaskets and clamping devices	„	Reg. 16 & 27(7)(c)
LL. 7	Machinery Space Openings	„	Reg. 17(1)
LL. 8	Miscellaneous Openings in Freeboard and Superstructure Decks	„	Reg. 18(2) & 18(3)
LL. 9	Ventilators	„	Reg. 19
LL. 10	Air Pipes	„	Reg. 20
LL. 11	Scuppers, Inlets and Discharges	„	Reg. 22(1)
LL. 12	Side Scuttles	„	Reg. 23
LL. 13	Freeing Ports	„	Reg. 24(1) & 24(5)
LL. 14	Protection of the Crew	„	Reg. 25(2)
LL. 15	Length of Superstructure	„	Reg. 34(1) & 34(2)
LL. 16	Sheer	„	Reg. 38
LL. 17	Minimum Bow Height	„	Reg. 39(1)(2)
LL. 18	Freeboard Tables	„	Reg. 28
LL. 19	Form of Certificates	1972	Article 18
LL. 20	Hatch beams and cover stiffeners of variable cross-section	„	Reg. 15(4)(5)(6)(7) & 16
LL. 21	Cargo ports or similar openings below the uppermost load line	„	Reg. 21(2)
LL. 22	Position of the inboard end of discharges when timber freeboard is assigned	„	Reg. 22(1)
LL. 23	Freeing arrangement	„	Reg. 26(5), 27(7) & 36(1)(e)
LL. 24	Negative depth correction	„	Reg. 31(3)
LL. 25	Effective length of raised quarter deck	„	Reg. 35(4)
LL. 26	Continuous hatchways as trunk	„	Reg. 36
LL. 27	Less than standard hatch coamings on trunks of less than standard height	„	Reg. 36(4)
LL. 28	Deduction for Superstructures and Trunks	„	Reg. 37
LL. 29	Sheer credit for superimposed superstructure	„	Reg. 38(5)(12)
LL. 30	Sheer allowance for excess height of superstructure	„	Reg. 38(7)(12)
LL. 31	Deduction for excess sheer	„	Reg. 38(15)
LL. 32	Special requirements for vehicle ferriers, Ro-Ro ships and other ships of similar type	„	
LL. 33	Timber freeboards for ships having reduced Type "B" freeboards assigned	„	
LL. 34	Freeboard for Lighters and Barges	„	Reg. 27(11)
LL. 35	Stowage of timber deck cargo on ships having timber freeboards assigned	„	Reg. 44 & 45

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THE WORK OF
THE
PORT OF LONDON AUTHORITY

J. Richardson

Paper No. 2. Session 1973 - 74

FOR PRIVATE CIRCULATION AMONGST THE STAFF ONLY

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THE WORK OF THE PORT OF LONDON AUTHORITY

by J. RICHARDSON

Introduction

As you are well aware, Great Britain is an industrialised island community located in the temperate part of the northern hemisphere. Its economy, therefore, is dependent upon the supply of food and raw materials from other countries which it partly pays for by means of manufactured and semi-manufactured goods.

Being separated from the mainland, the only means of transportation available for its overseas trade is by sea or air, although, if the Channel Tunnel becomes a reality this would also give a road-rail link with the European continent.

Sea transport is the main trade link with air transport slowly making inroads into the high value/low bulk trades of the United Kingdom. At present 15 per cent (by value) of all imports and exports is now carried by air freight. As a percentage of weight this figure would be considerably lower.

For a long time London and Liverpool dominated as the major sea ports handling well over 30 per cent of all traffic. Both have fallen slightly in recent years, Liverpool rather more than London, whereas Southampton and Harwich are showing improvement with several of the smaller ports also making progress, especially Dover and Felixstowe.

London, however, remains the major U.K. port, handling over 21 per cent of exports and 17 per cent of imports. Once again these figures are based on value.

The Port of London

This then is what the Port of London is all about, a vital link in the chain of transporting food, materials and products from supplier to consumer. To this end, it provides facilities for cargo handling in respect of a wide range of commodities. Being a river port the majority are many miles inland with direct or easy access to factories, refineries, and power stations.

The majority of wharves, refineries, factories, etc., fronting the river are independently owned, but the enclosed dock systems of India and Millwall, the Royal Group and Tilbury Docks are owned and controlled by the Port of London Authority as are the riverside facilities of the Grain Terminal and Tilbury Passenger Landing Stage.

In addition the Port of London Authority is responsible for the control of shipping in the 94 miles of the tidal Thames from the estuary to the up-river limits of the tidal waters at Teddington.

The Port of London Authority

The Port of London Authority is a commercial undertaking, relying on profits for its continued existence, controlled by a Board whose members are appointed by the Secretary of State for the Environment after consultation with various bodies. It was formed by Act of Parliament in 1908, and began to trade in March of the following year. Under this Act it assumed responsibility for the existing dock companies which were in poor financial straits and which had been the subject of an inquiry by a Royal Commission a few years earlier. It also took over the function and power of the Thames Conservancy in relation to the tidal waters of the river.

Although history shows that London had operated as a port at least from the time of the Romans, the Dock Companies did not come into existence until the formation of the West India Dock Company by Act of Parliament in 1799. The next 86 years, however, saw the opening or extension of nine further docks, the last one being at Tilbury in 1886.

The only changes since that date are the construction of King George V Dock in 1921 as part of the Royal Docks complex (this made it possibly the largest impounded dock area in the world), the extension at Tilbury to cater for the container revolution in the early sixties (which helped to give London its predominance as a container port in this country) and the introduction of large unit loads of packaged timber, and the grain terminal.

At the same time, as transportation becomes more sophisticated and with the changing pattern of traffic, the need for facilities to handle what is known in the port industry as conventional or break bulk cargo has reduced considerably. As a result it has been found necessary for economic reasons to close the small up-river docks, such as East India, Surrey Commercial, London and St. Katherine. Also the need for warehousing of goods has been drastically reduced, reflected by the closure of cold storage facilities, quayside warehouses, and the recent press announcements that the Cuther Street Warehouse had been sold.

The closure of these operating areas does not mean that the P.L.A. is on the verge of bankruptcy, an examination of its accounts for 1972 will, in fact, show the reverse. After many years in the red, a small profit was made in 1971 followed by an operating profit in 1972 in excess of £1 million and it would now seem that the corner has been turned. Of course the closure of unprofitable activities has released real estate for development purposes which has helped to finance new projects and repay some of the borrowed capital. The operation of a voluntary severance scheme, attractive to both the Authority and the employees had the effect of reducing the labour force to realistic proportions in the light of current requirements.

The Enclosed Docks—Traffic

Within the enclosed docks and at the Grain Terminal just over ten million tonnes of cargo is handled, which is slightly less than 50 per cent of the total port trade (after excluding crude oil, petroleum products and coal). Of this 8,8 million tonnes passes over the Authority's quays or premises. The remainder, approximately $1\frac{1}{2}$ million tonnes, is discharged (and conversely loaded), overside into lighters for delivery to riverside wharves. These lighters enter and leave the docks free of charge, due to the inclusion of a clause, known as the Free Water Clause, in the Act of 1799 incorporating the West Indian Dock Company (as previously mentioned). Despite the fact that the barges are not liable to dock charges, the lighterage industry has declined drastically over the years. This can be seen when one considers the 4 million tonnes of overside traffic of 1968. The P.L.A's own lighterage section has seen substantial cuts over the past few years.

Of the 8,8 million tonnes handled over P.L.A. premises, approximately two-thirds is import traffic, with specialised facilities for grain, containers and packaged timber handling 78 per cent. As these facilities also handle 54 per cent of the export traffic, it means that the conventional cargo berths within the docks are now handling only $2\frac{3}{4}$ million tonnes, or rather less than a third, of the traffic. This compares with five million out of seven million tonnes in 1968 (i.e. over two-thirds of the traffic).

The Enclosed Docks—Cargo Handling

It should be noted that although the P.L.A. controls the dock operations and receives the revenue for cargo handling, most of the stevedoring activities aboard ship are carried out by independent stevedoring companies, as is a fair proportion of the quay work. The P.L.A. has, however, recently acquired the Thames Stevedoring Company Ltd. and Metropolitan Terminals Ltd. thereby increasing its involvement in these areas.

FIG. 1

Loading motor vehicles for export by means of electrically operated quay cranes.

Even within the same dock the conditions under which cargo is discharged vary considerably, although for conventional export cargo the practice is fairly consistent throughout all docks. For exports the P.L.A. shed gang receive the goods ex. lorry (formerly goods were also received ex. rail, but this has now been discontinued), stow it in the shed, then when the ship is ready for loading deliver it to the quayside for the quay gang (employed by the stevedoring company) to ship off.

Imports on the other hand are handled under the following conditions:—

(i) P.L.A. discharge—the P.L.A. perform all operations both discharging from the ship, and landing and delivery on shore.

(ii) Overside conditions—the ship and landing operations are carried out by the stevedoring company, and the receiving into shed and the delivery to road vehicles are carried out by P.L.A. labour or by stevedoring labour acting on behalf of the P.L.A.

(iii) Quay and Shed Space Agreements—in these instances the shipping companies employ stevedores to perform both the ship and shore operations for which they receive a fixed rate per tonne from the P.L.A. for receiving and delivery. In return they pay a nominal rent for use of the shed. This has historic connotations and is not really satisfactory either to the shipping companies or the P.L.A. Studies are being carried out to enable a solution to be reached that would be acceptable to all parties. When goods are discharged or loaded overside the company performing the stevedoring operation also supply the labour aboard the craft.

The Enclosed Docks—Shipping

In 1799, because of the general state of disorder due to the overloading of the river, which, if it had continued would have made navigation and trade impossible, and also due to the considerable losses being incurred by theft, the Act was passed authorising the construction of a dock on the Isle of Dogs. From this beginning the dock system expanded to the situation that exists at present.

Looking at the situation in retrospect, it is obvious that in a tidal river the state of the tide controls the timing of a ship's movements and its discharge or loading. In an enclosed dock, however, the ship can be handled unaffected by tidal movement. Of course, the tide still imposes its restrictions, as movement in or out of the dock is limited around the two tides per day.

Entry into the dock is by means of a lock. When the ship enters the lock from the river the entrance is brought to the level of the river and the outer gate closed. The water in the lock is brought up to dock level, the inner gates are then opened to allow access to the berth.

The costs of constructing, maintaining and operating the locks are considerable and each dock now has only one entrance for commercial shipping. It is the dimensions of these locks which control the size of ship which can be accommodated, although the sill depth at certain berths also restrict the size of the ship capable of being handled at these berths.

Dimensions in feet of the various lock entrances are as follows:—

	Length	Width	Depth
India and Millwall	584	80	35
Royals—King George V	800	100	45
Tilbury	1000	110	45½

FIG. 2

Fork lift truck handling cargo from the specially designed side discharge/loading vessels of the Olsen Line.

India and Millwall Docks

With the closure of other up-river docks, India and Millwall Docks are now the most central of all the dock systems, being just over two miles from the City.

These docks house the Olsen Terminal, constructed and operated by the Fred Olsen Line. It is capable of handling five ships at a time and has its own passenger terminal comprising immigration, customs and waiting accommodation. A feature of the ships is that they are specially designed side discharge/loading vessels, the cargo (mainly fruit ex. Canary Islands) being handled by fork lift truck both on quay and aboard ship.

P.L.A. operated berths include the three storey shed at 19 Berth constructed in 1967 for Far East Imports. There is road access to the ground and first floors which enables ships to be unloaded in quick succession without the need for excessive handling of cargo. The top floor provides for the storage of cargo which has yet to be delivered, minimising the risk of congestion on the lower "transit" floors.

In the remainder of the docks the main imports are fresh fruit and vegetables, dried fruit, timber, motor vehicles, canned goods, rubber, etc., from America, New Zealand, Scandinavia, The Baltic, Mediterranean, Near and Far East.

London Dock was long associated with the wine trade, but when it was closed the 800 000 gallon Bulk Wine Installation at Garnet Street was retained. The operation is now controlled by India Docks which has taken over the role from London Docks and in addition has its own 980 000 gallon terminal with glass fibre tanks. In 1972 these installations jointly broke all records by handling over 5 million gallons, one company alone importing $1\frac{1}{2}$ million gallons. Apart from this nearly 3 million gallons were pumped direct from ship to road tanker.

The tanks were designed for the delivery of wine to road tanker, but with the possible increase in tanker traffic as a result of Britain's entry into the Common Market it is considered that throughput will increase as the tanks are also capable of receiving from road tankers.

FIG. 3

India and Millwall docks.

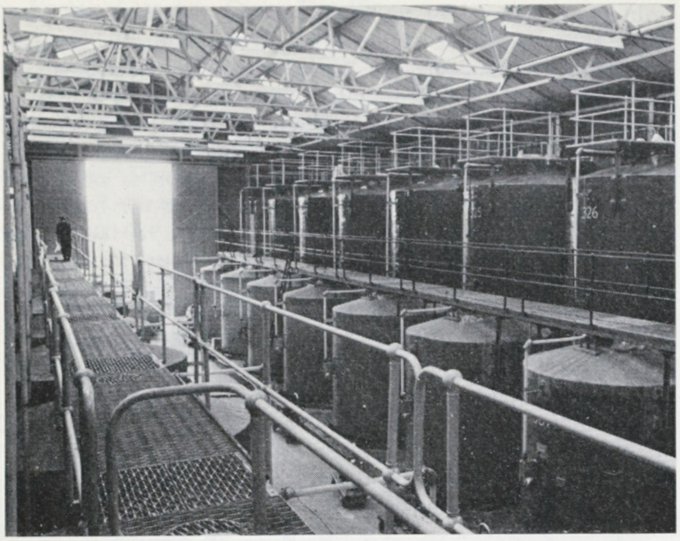

FIG. 4

Internal view of the Bulk Wine Installation at India Docks showing the glass fibre tanks.

FIG. 5

Loading of road tankers at the bulk wine berth direct from ship.

Royal Group of Docks

By far the largest of the P.L.A's dock systems, with a water area of 230 acres and 11 miles of quay. It comprises the Royal Victoria, Royal Albert and King George V Docks. Victoria Dock, like the other up-river docks, is a victim of the changing pattern of traffic and remains open solely for the handling of South American meat (retained after much negotiation by the P.L.A. and resulting in the take over of Thames Stevedoring Co. Ltd.), the discharge of grain to three privately operated flour mills (now mainly serviced from the Grain Terminal at Tilbury) and a small amount of warehousing (mainly tobacco) and groupage work performed by a P.L.A. subsidiary.

An unusual feature of the King George V Dock is that the quay cranes on the south side are located on dolphins situated 32 feet from the quay to enable barges to be loaded or discharged while the ship is being worked.

The basin at the eastern end of the Albert Dock has also been closed for cargo handling purposes. A look at this area will now disclose a private marina and small boat auction, a business which seems to be thriving in the South East part of England. Also one large transit shed was demolished to accommodate an office complex to house staff previously located in the City at Trinity Square and St. Katherine Dock House.

Apart from meat and grain there are no specialized facilities, a mixture of imports and exports, to and from, all corners of the world are handled. Far Eastern Conference and North American vessels were once a feature of these docks but with the advent of containers on these routes this traffic has diminished.

Tilbury Docks

Situated down river 25 miles from London Bridge, Tilbury is a dock of contrasts, with older facilities handling break bulk cargo existing alongside the recent extensions and developments for accommodating roll-on/roll-off (RO/RO) traffic, containers and packaged timber. Even so development continues with the construction of more modern facilities to replace the older transit sheds.

Nowadays when people think of Tilbury they think of the new extension, which of course is a child of the container and unit load revolution. The first stage of the construction, however, was to house a RO/RO service, a cheap and popular method of transportation between the U.K. and the European continent, and large modernised transit sheds for handling export traffic to India and Pakistan with greater use of mechanized equipment.

The second stage (of nine berths) comprised six container berths, five of which are now common user berths operated by the P.L.A. with O.C.L., at 39 Berth, carrying out the U.K. terminal operations for the Australian/European container service. Packaged forest products are handled at the other three berths, on lease from the P.L.A., by MacMillan Bloedel Ltd., Svenska Celulosa and Seaboard Pioneer Terminals Ltd.

Apart from general cargo the P.L.A. operates its own packaged timber berth which was developed in 1966. Besides bringing new business into London it retained traffic which might otherwise have been lost as timber shippers adopted larger and deeper draughted vessels, and was a big influence in the further development of tenanted berths for this type of cargo. On occasions 4000 tonnes of packaged timber have been handled in a single day at this berth.

At 26 Berth can be found the stern loading RO/RO vessels of the Swedish Lloyd Line. Formerly, when vessels were discharged and loaded by conventional means using quay cranes and ships's gear, it took six days. Nowadays, it can be done in only eight hours.

Further new developments taking place at Tilbury include the construction of a new terminal for the West African service to replace three transit sheds on the south side of the dock. This traffic was previously operated by a stevedoring company in whom some of the member companies of the Conference had interests, this company has now been taken over by the P.L.A. who will in future perform both the ship and shore operations.

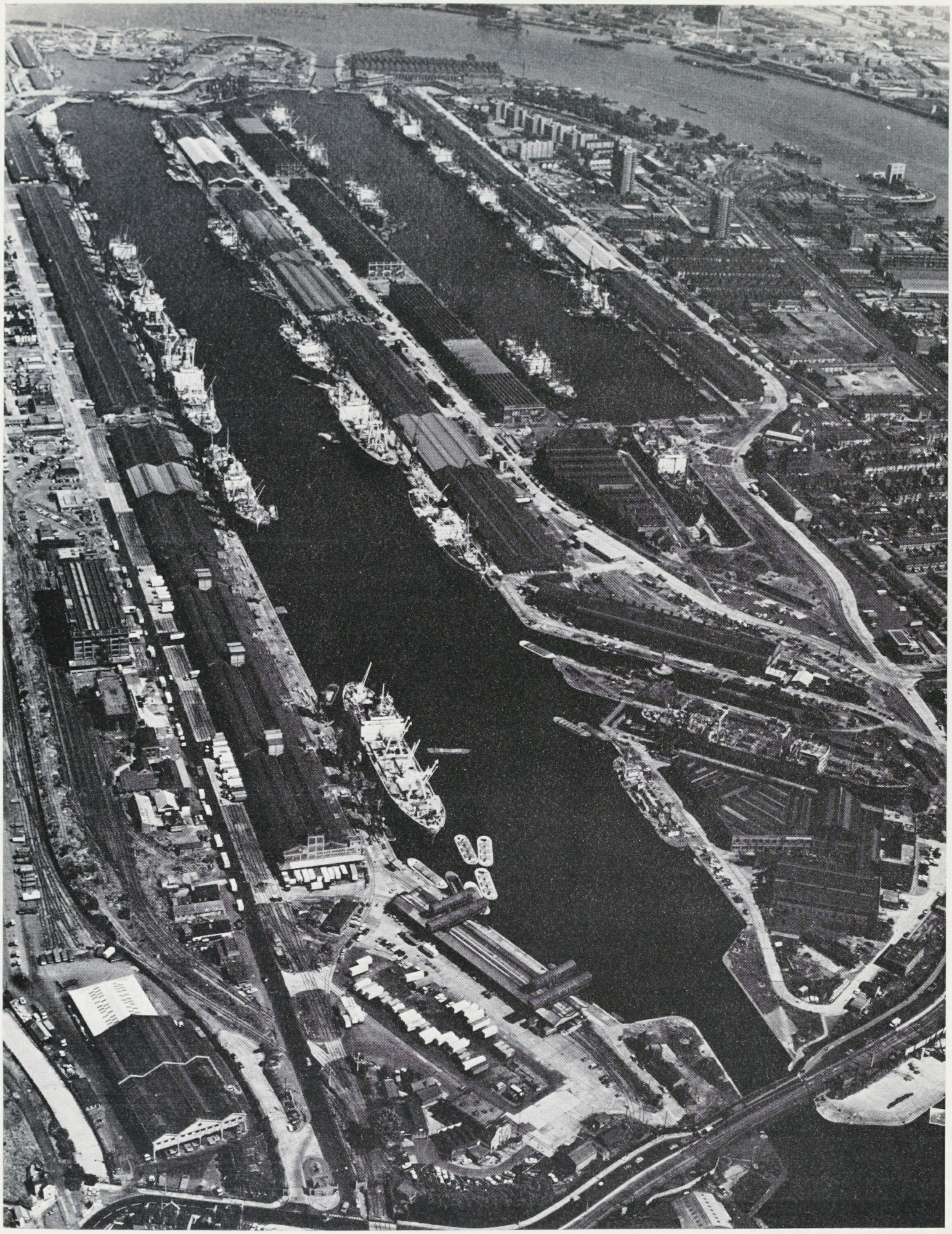

FIG. 6

King George V and Royal Albert Docks.

FIG. 7

The *Jervis Bay* unloading at 39 Berth, Tilbury Docks.

FIG. 8

O.C.L. operations at 39 Berth, Tilbury Docks. The automatic warehouse and container crane, with the conventionally operated berths in the background, can also be seen.

Tilbury Riverside Facilities

Included as part of the Tilbury Dock system are the cargo and tanker repair jetties which are now leased for ship repair work. Vessels also come alongside the cargo jetty to pump ashore latex to the large Symington tanks situated between the main dock and the river.

Down river on the other side of the tidal basin (closed because of the high cost of keeping it clear) is the passenger landing stage. The up-river section is owned by the P.L.A. and is capable of handling large ocean-going passenger vessels and the services operating from here include educational cruises. (The adjacent riverside station, with its regular service to Fenchurch Street, gives easy access to central London.) This is another of the P.L.A's facilities that is being modernised with the intention of attracting a bigger share of the RO/RO traffic to London. British Rail own the downstream section from which it operates the Gravesend Ferry.

Grain Terminal

London is the major grain importing port in the U.K. enhanced by the construction of the Grain Terminal at Tilbury which came into operation in the late sixties. Liverpool is now making a serious challenge for this trade having constructed a grain terminal at Seaforth which came on stream in 1972, but at present labour relations' problems are being encountered.

At Tilbury, the jetty is 900 ft long and capable of accommodating vessels of 65 000 tons dwt. although the depth can be increased to allow 90 000 ton ships.

There are two elevator towers, with a maximum discharge rate of 1000 tonnes per hour each, feeding the silos which are used for long or short term storage.

The silos, which can also be fed by road/rail and discharge to road/rail and barge, have a capacity of over 100 000 tonnes. Land is available for the construction of further silos if required to more than double this quantity.

The River

The 94 miles of the tidal Thames are used by a multitude of vessels ranging from small skiffs at Richmond to the bulk carriers at the oil and grain terminals. Despite the differences in the navigational requirements and the revenue derived from the various sources, the P.L.A. must fulfil its statutory responsibilities to all users of the river.

To this end a Harbour Master is appointed to maintain a safe obstruction-free fairway for the use of all shipping entering or leaving the Port of London. He is also required to encourage commercial enterprise on the river, providing potential customers with advice based on experience and local knowledge while at the same time ensuring that the interests of existing users are safeguarded.

In order to carry out these responsibilities he has at his disposal the Thames Navigation Service and a fleet of patrol launches.

The Thames Navigation Service provides a 24-hour communications link between ship and shore using radar, VHF, telex, teleprinter and radio linked tide gauges. Basically the operation consists of receiving advance information on ship movements at Gravesend (the main centre) from where it is fed to the operations room at Gallions and the dock entrances. This is done by means of a forecast programme which indicates the time and place of particular vessel movements. The actual movements are then monitored by direct link on the appropriate VHF Channel and by use of radar displays, the latter especially during periods of low visibility when the changing situation must be kept under constant review. Broadcasts from the operations room are made throughout the day at half hourly intervals in all weather conditions advising and warning ships as necessary. The P.L.A's accident record is outstanding, within the past few years only two major incidents have occurred. In neither case could the P.L.A. have been faulted and in one of the instances the incident could have

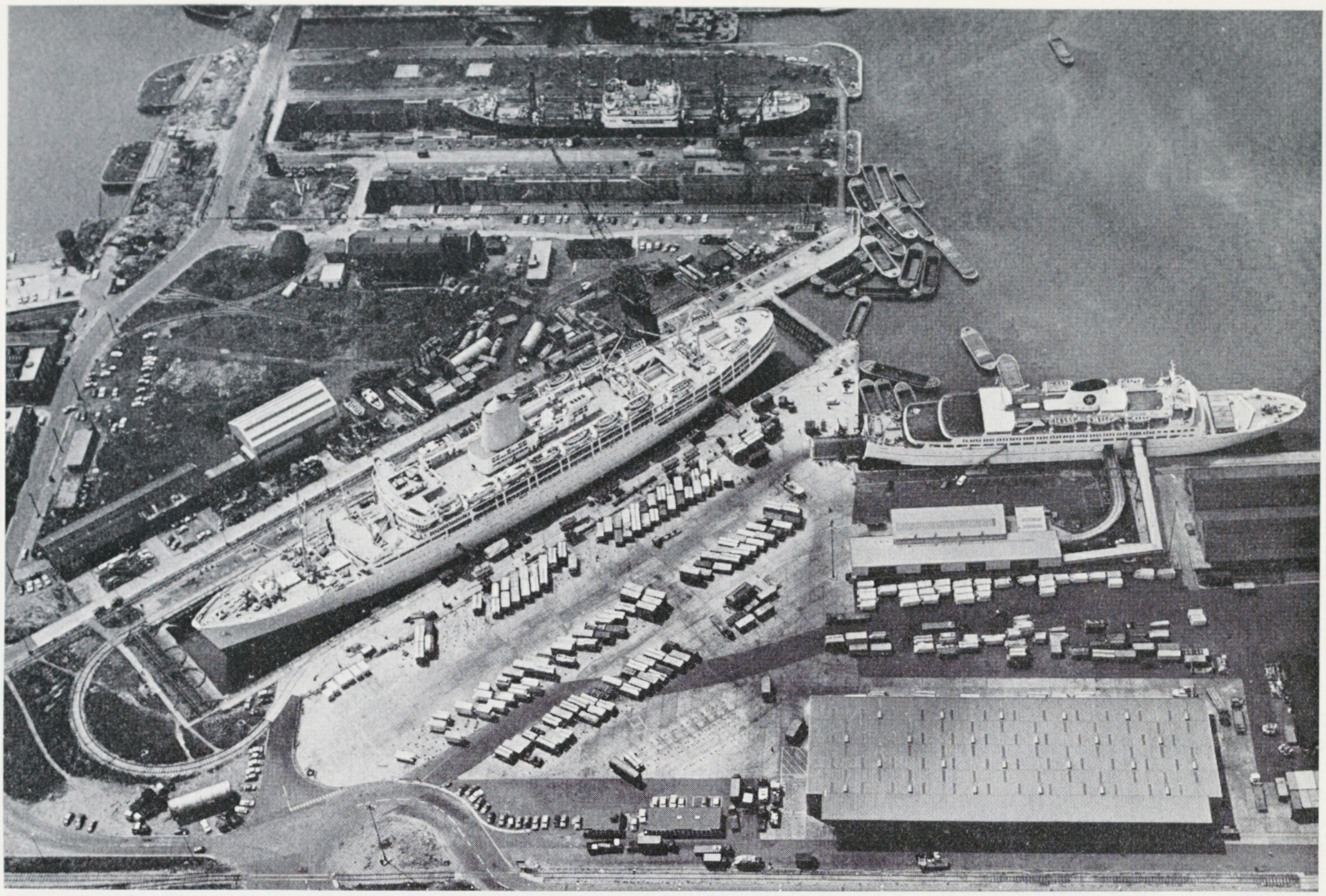

FIG. 9
RO/RO facilities at 26 Berth, Tilbury, with adjacent dry docks

been avoided if harbour service advice had been taken and the ship properly equipped communications-wise. By the time this paper is presented radar coverage will have been extended by the completion of a further radar station at Warden Point giving greater coverage of the estuary and linked to the main centre.

Continuous 24-hour coverage is also maintained by the harbour service launches, normally by three during the day and two at night. Under the supervision of experienced River Patrol Officers the launches physically monitor the situation, ensuring that shipping and other river users conduct themselves in a safe and seaman-like manner and comply with all the relevant regulations. They also locate and mark sunken vessels and other hazards until removal, and monitor constructions on the river to make sure that there is no infringement of the licence.

Regulations which must be complied with include:—

- Port of London Act 1968
- River Bye-Laws
- Petroleum Spirit Bye-Laws
- Explosives Bye-Laws
- Hazardous Goods Regulations
- Calcium Bye-Laws
- Methane Bye-Laws
- Notices to Mariners

In addition the Harbour Master organises ceremonial occasions, such as the recent opening of the new London Bridge, visits of foreign dignitaries, funeral processions, such as that of Sir Winston Churchill, and to ensure that river events, firework displays and boat races are properly organised and adequately supervised.

River Traffic

Although the Docks are the main revenue earners of the P.L.A., three commodities handled at riverside facilities account for nearly two-thirds of the port's total trade, namely Oil, Coal and Sea Dredged Aggregates.

Of the 28 million tonnes of oil shipped in 1972, over 24 million was imported (which makes London Britain's most important oil importing port), over half of which was in crude form to the refineries at Coryton, Shellhaven and Thameshaven. In addition plans have been approved for refineries to proceed at Canvey Island. Further decisions are still awaited on plans to build a refinery at Cliffe on the south side of the river.

Coal figures prominently in tonnage statistics for London, nearly four million tonnes being imported in 1972, although it cannot in the normal sense be considered a coal importing port. The bulk of the coal is for consumption by the C.E.G.B. power stations for the production of electric power. In recent years the conversion of power stations to oil and gas has caused a sharp reduction in the amount of coal imported (in

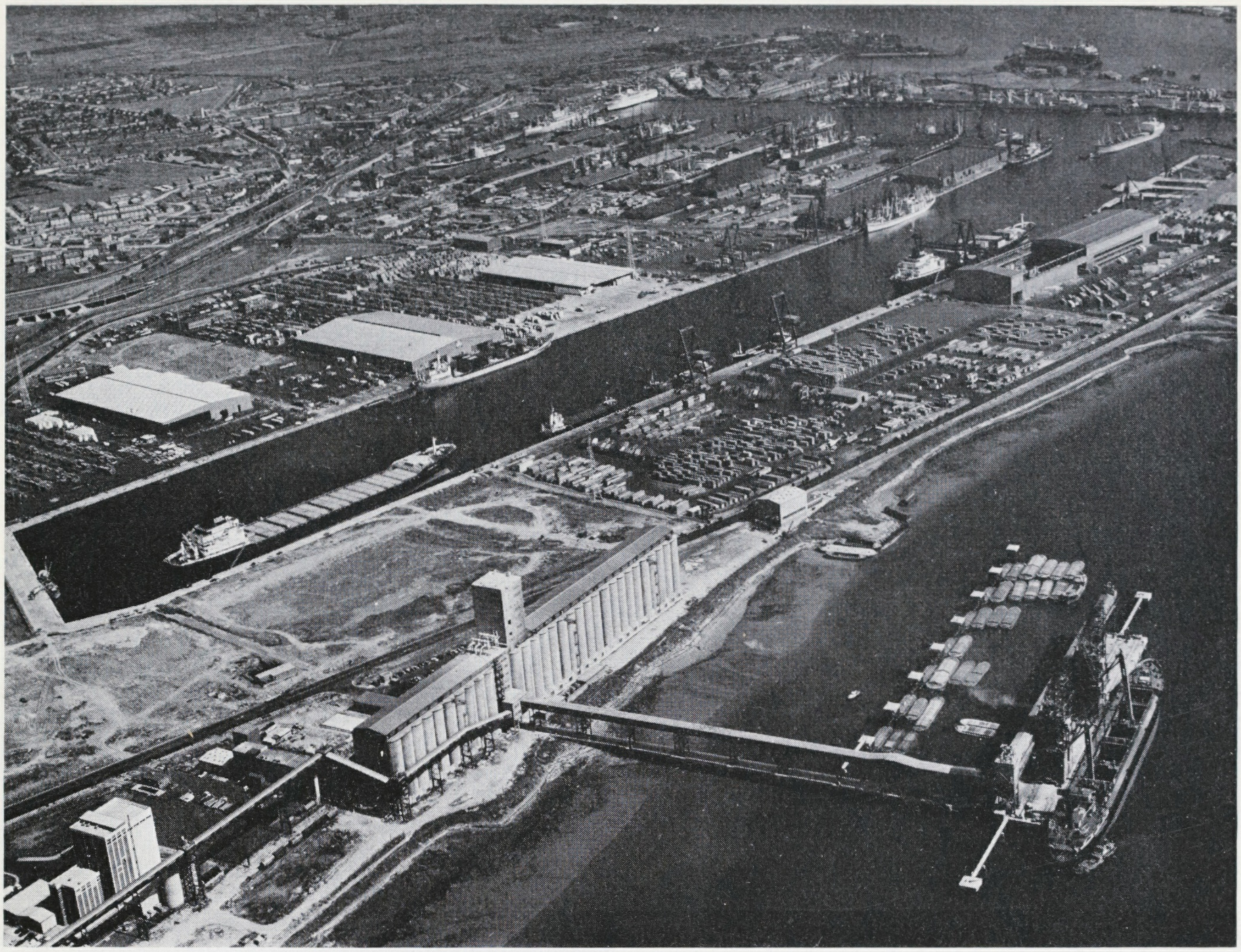

FIG. 10

Tilbury Docks and the grain terminal.

1968 the figure was six million tonnes). Government policy on the future of Britain's coal mines will be a major influence on the rate of change in the next few years and it is thought that the decline may not be so rapid.

The third major import, Sea Dredged Aggregate, is brought in by dredgers from coastal and estuarial waters for discharge direct to privately owned riverside plants where it is processed for use in major construction and road works. If the growth in this industry continues it will not be too long before it supplants coal as the second largest commodity handled in London.

Container traffic also plays a big part in the river with wharves such as Victoria Deep Water Terminal and the advent of Sea-Bee barges with the provision of a special mooring at Gravesend for the Lykes Lines service. LASH barges are also brought into the Thames transhipped from the parent ship moorings in the Medway.

In circumstances where it is not practicable for vessels to enter dock or tie up at a riverside berth, such as when explosives are being handled, the P.L.A. provide moorings and anchorages to enable vessels to discharge or load.

Other traffic handled at riverside wharves include sugar, motor vehicles, RO/RO services, soya bean oil and meal, grain, cement, paper and paper making materials.

Up river and in the Pool of London, tourist traffic and river amenities play a significant part including passenger boats operating between the various piers, H.M.S. Belfast, floating restaurants, house boats, hovercraft and hydrofoil services, yacht moorings and marinas.

Hydrographic Service

To enable the Harbour Master to properly fulfil his function, it is necessary for the 94 miles of river to be properly surveyed and charted. Performing this requirement is the Authority's Hydrographic Service which is divided into three highly specialised survey units each with its own headquarter's craft. They carry out the work using radio positioning by means of Decca Hifix, echo sounders and sonar. For the complex of sand banks and channels in the estuary which are the subject of constant change, automatic data processing using a

FIG. 11

Headquarters of the Thames Navigation Service at Gravesend.

FIG. 12

Radar display unit in the operations room at Gravesend.

FIG. 13

H.M. the Queen aboard the P.L.A. launch *Nore* on the occasion of the opening of the new London Bridge. In the background can be seen H.M.S. *Belfast* at its river mooring.

digital computer is being developed. In addition to charting for depths, studies are made of water movement and the transport of sediment; this is particularly relevant in connection with the Maplin Seaport development where a great deal of work of this nature has been carried out. Seismic reflecting investigations are also made to determine the depths of sediment.

In addition to performing its routine functions this service markets its specialised services in competition with commercial enterprises and its charts are always in great demand. These charts are also a constant source of reference within the Authority especially when considering the provision of moorings and the requirements of potential customers.

Salvage Service

As with the Hydrographic Service, the Salvage Service also plays a major part in keeping the fairway clear under the P.L.A's statutory obligations. It is incumbent upon the Authority therefore to ensure that it has the expertise and equipment to carry out these duties, or to ensure they are carried out, with a minimum of delay so that the running of the port is not affected. In a recent incident a ship was raised by P.L.A. craft, repaired and ready to sail within 48 hours of sinking. In the case of an earlier sinking in the estuary it was found necessary to bring a sheerleg from the continent to avoid disturbance to shipping.

The salvage fleet consists of five craft (complete with divers) capable of a bow lift of 120 tons (four or these were used recently to lift the P.L.A. tug Plangent which had sunk in Royal Docks) and two dumb tidal lifting camels with a combined side lift of 2400 tons.

Apart from the raising of wrecks, sunken barges, lost anchors and even abandoned cars, the salvage fleet carry out the provision, placing, maintenance, removal and inspection of moorings which can be seen the length of the river. Work is also performed for outside interests on jetties and underwater structures and when necessary assisting in the repair and removal of lock gates.

FIG. 14
Mobil Pegasus 211 666 tons dwt., the world's first double-bottomed super tanker, at Coryton Refinery, indicating the size of tanker that can be accommodated in the Thames.

FIG. 15
The hydrographic survey vessel *Maplin* used for charting the deep water channels.

FIG. 16
The *Crossness* shown above with its three sister ships, the *Hookness, Broadness* and *Stormness* form the backbone of the P.L.A. salvage fleet.

Dredging

The dredging fleet of the P.L.A. now confines itself mainly to the dredging of lock entrances and the dock berths by means of grab dredgers discharging into hoppers which are then taken to the reclamation unit at Rainham where the spoil

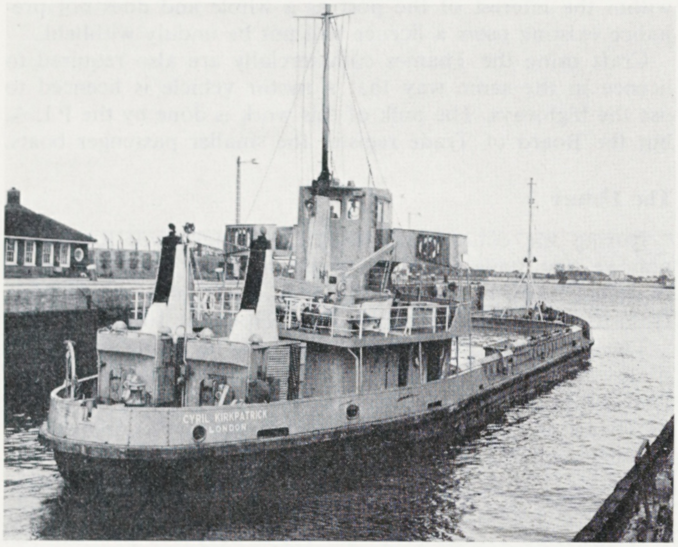

FIG. 17

The self propelled hopper, *Cyril Kirkpatrick,* leaving Royal Docks loaded with spoil for discharge at the "pump ashore" unit at Rainham.

is pumped into lagoons under a planned programme. In this way the P.L.A. not only have a suitable site for the long term disposal of its dredged materials, which previously had to be taken out to Black Deep for dumping, but also are contributing to land reclamation in this area.

Dredging in the main river channels is carried out by contractors using trailer suction dredgers, the possibility of the P.L.A. itself undertaking this work is under review and trials and economic appraisals are being carried out.

FIG. 18

One of the P.L.A's "A" class tugs used for towage within the enclosed docks.

Towage

Within the enclosed docks the P.L.A. carry out all ship towage operations either by the use of its own tugs or by those hired in from towage companies. On the river, however, the independent contractors perform these operations as they do for the movement of lighters both in the docks and on the river. The P.L.A. does, however, use its own tugs in connection with its own lighterage activities.

Heavy Lifts

The bulk of the cargo handled in the docks is by quay crane or ship's gear. On occasions, however, due to the nature or weight of the lift, the quay loading, or dependent upon whether the ship can bring its own gear into use without

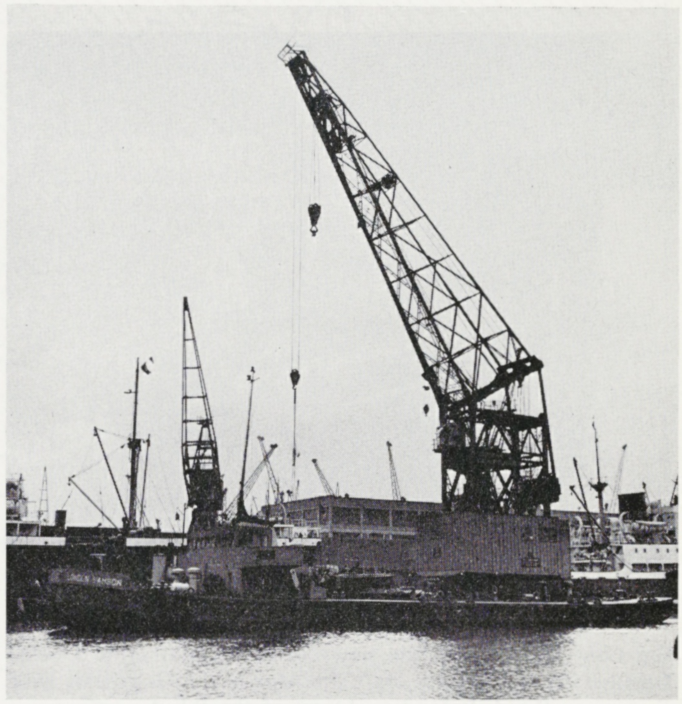

FIG. 19

The *London Samson* (one of the P.L.A's five floating cranes) now capable of lifting up to 120 tons.

interfering with its other operations, the work may be performed by the P.L.A's floating derricks. By far the largest of these is the London Mammoth with a lifting capacity of up to 200 tonnes. In recent years the demand for lifts of this nature have declined to such an extent that it is now manned only as and when it is required. Modifications to the other derricks have now given them greater flexibility (up to 120 tonne lift) so that the need for the Mammoth is further reduced.

Pollution Control and Driftwood Collection

The P.L.A. has the distinction of being the only Port Authority to hold full pollution control powers with the statutory appointed River Conservator being an officer of the P.L.A. With the advent of the Regional Water Authority in 1974, however, the P.L.A. will lose its responsibility for pollution control in the Thames although it will still be responsible for the clearance of oil.

In recent years the success of the pollution control team is due to the close co-operation which it has had with the Greater London Council and other local authorities, who have spent considerable sums of money improving sewage works and other outfalls into the river. The results can be assessed by the numbers and varieties of fish which can now be found in the Thames.

Driftwood is a hazard to all forms of shipping and constant effort is expended in collecting and burning it by both the P.L.A. and other organisations. The big problem, however, is to try to prevent it at source. In many cases this can be accomplished with the P.L.A. exercising control of demolitions and constructions on the river front and keeping the docks as free from dunnage as possible to ensure that it doesn't float into the river when the lock gates are opened.

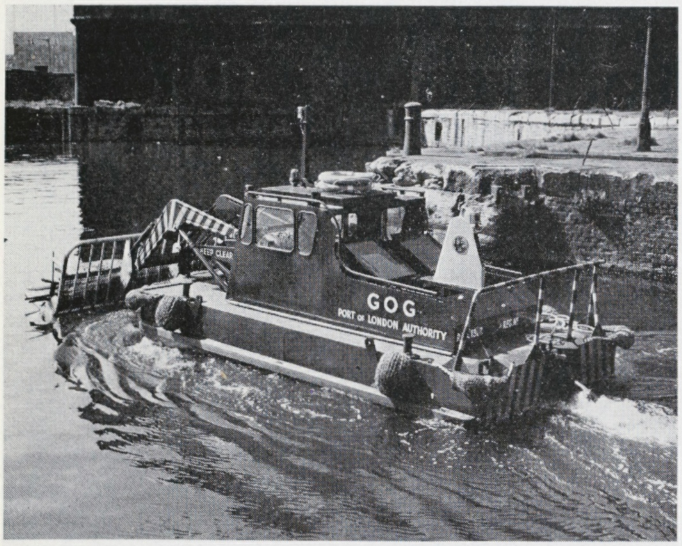

FIG. 20

The *Gog* in action in the now closed St. Katherine Docks. Together with her sister craft the *Magog* the *Gog* deals with the driftwood problems of the P.L.A.

To fulfill its statutory obligations of pollution control and keeping the fairway as clear as possible of floating debris the P.L.A. has itself spent over £½ million in the past five years.

Licensing and Registration

A further function of the P.L.A. is acting as licensee as regards the employment of dock labour and carrying on of trade on the river.

When a potential customer wishes to commence trading or an existing user to extend his business, plans must be submitted to the P.L.A. to ensure that any building works are acceptable from a navigational aspect. If the project is also within the interest of the port as a whole and does not prejudice existing users a licence will not be unduly withheld.

Craft using the Thames commercially are also required to licence in the same way that a motor vehicle is licenced to use the highways. The bulk of this work is done by the P.L.A. but the Board of Trade register the smaller passenger boats.

The Future

During the course of this paper changes will have been noticed that have occurred in recent years with containers replacing break bulk cargo and dock operations moving away from the centre of London. What then of the future?

The P.L.A., as mentioned earlier, will be losing its responsibility for pollution control to the new Regional Water Authorities, the Thames Barrier construction could well bring problems not yet apparent as could the construction of a channel tunnel.

A great deal of publicity has been given to the construction of a third London airport at Foulness which has possibly overshadowed P.L.A. proposals for a deep sea port and oil terminal on the Maplin Sands. This has been on the stocks for many years and a great deal of research has been carried out, including the building of a hydraulic tidal model which completely occupied a large transit shed at Surrey Docks. Even at this early stage a strong management team has been set up, to ensure that the problems both commercial and engineering can be met and overcome as they arise.

Another subject which has also been given much publicity is the report on the Dockland study. This was initiated by the Secretary of State for the development of redundant dockland for housing, recreational facilities and other social needs. It does assume future dock closures which are not the views of the P.L.A. (which owns about half the land under review) although the P.L.A. did co-operate by providing information, recognising the opportunity for development in the up-river areas made possible by the gradual move of the port down river. At the same time the P.L.A. as port operators, protecting the interests of its workers, customers, tenants and stock holders, will be looking for a considerable degree of flexibility in any plan if it is to win trade and maintain employment in an industry in which long term planning, at present, is very difficult.

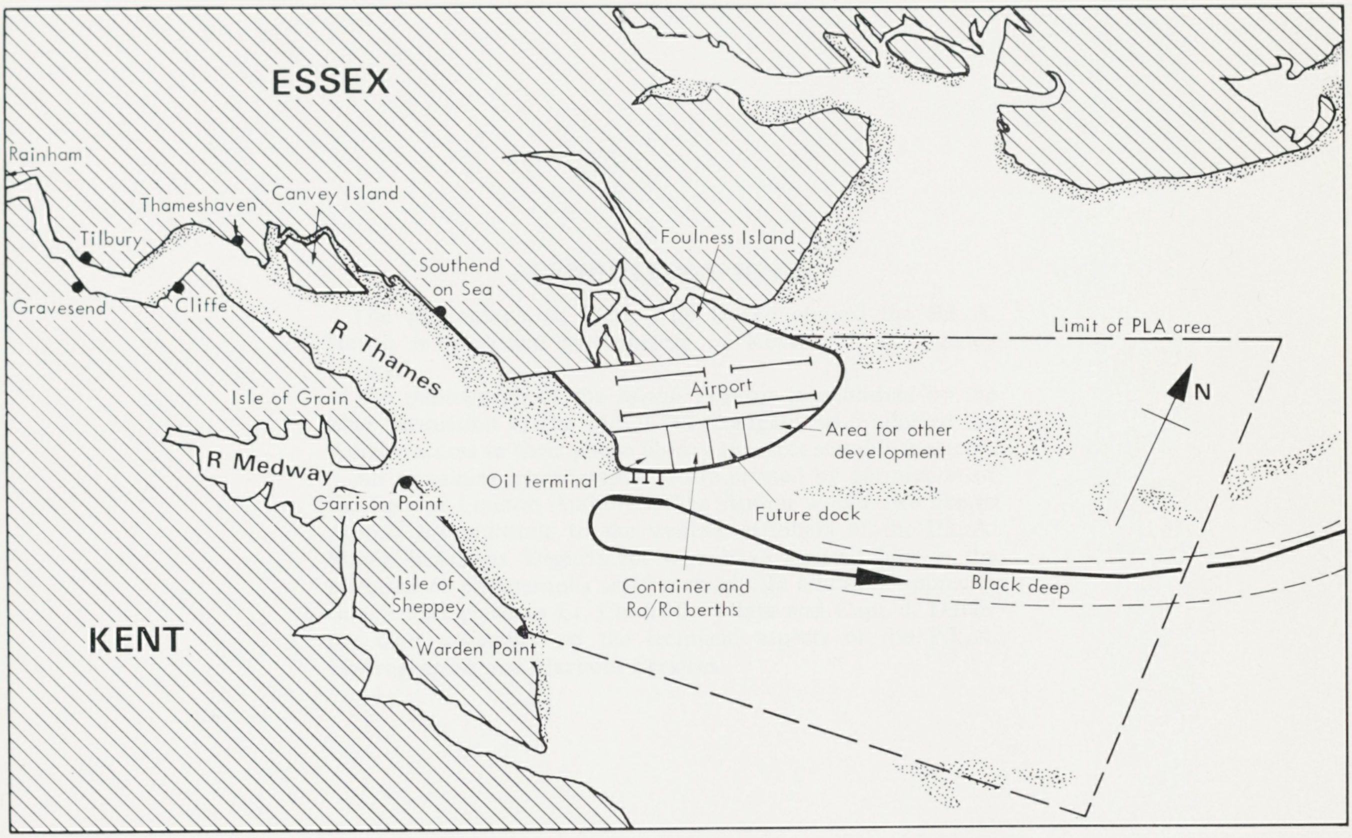

FIG. 21

Thames Estuary showing possible deep water approach channel to proposed Maplin Seaport.

ACKNOWLEDGEMENTS

The photograph of H.M. The Queen aboard the P.L.A. launch is published by courtesy of Keyston Press Agency Limited.

The photograph of the *Mobil Pegasus* is published by the kind permission of the Mobil Oil Company who allowed the Author access to their photo library to select suitable material.

All remaining photographs are re-printed by permission of the Port of London Authority. The Author would also like to express his gratitude to the various members of the P.L.A. Public Relations Department who have assisted him in the selection of photographs and brochures. In addition, appreciation is also given to Lt. Cmdr. G. White and Capt. J. Darby for their assistance on the technical aspects of the P.L.A. Hydrographic and Harbour Services.

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Lloyd's Register Technical Association

A BRIEF GUIDE TO THE PREPARATION AND PRESENTATION OF TECHNICAL PAPERS

C. Cummins

Paper No. 3. Session 1973 - 74

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A BRIEF GUIDE TO THE PREPARATION AND PRESENTATION OF TECHNICAL PAPERS

by C. CUMMINS*

SYNOPSIS

This guide for authors is intended to be of assistance in its content and example. It is presented in the preferred arrangement, from Title to Index, including a Glossary but excluding a Notation, which is not required in this case by the subject material.

The main text covers some of the problems facing authors, bearing in mind the object in writing the paper and the limitations in length proposed. Textual details discussed which are of importance to the author, include length, style, subdivision into sections, spelling and punctuation, printing instructions, abbreviations and units, numerals and mathematics. This is followed by special notes regarding the typing of the draft to facilitate editing, refereeing and printing.

The problems regarding illustrations are afforded separate treatment in Section 3 of the paper and Section 4 deals with the oral presentation.

TABLE OF CONTENTS

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* Engine Surveyor, RATAS, H.Q.

1 INTRODUCTION

It is the wish of the Committee of Lloyd's Register Technical Association that authors be given every facility to prepare and present useful papers of a high standard. The intention of this paper, therefore, is to draw the author's attention to various aspects which may be of assistance in presenting the subject material in the best possible manner.

Many institutions and associations have their own instructions and notes for authors which are available on request and the content of some have been considered for the preparation of this Guide. Although primarily intended for the preparation of Technical Association papers, special requirements requested by various institutions may also be of use and are discussed in Appendix 1.

Manuscripts submitted to the senior institutions are critically examined by referees who may reject important material due to inadequate presentation. Papers so rejected reflect adversely on the author and he should, therefore, be encouraged to scrutinize his draft most carefully.

It is not the intention of this paper to discourage potential authors from writing in their own style. Papers produced to a set of rules would be lacking in personality and uninteresting to read. It is hoped that authors, after preparing the first draft of their papers, will be advised by this Guide but not ruled by it.

2 MAIN TEXT

2.1 Purpose

The object of writing a paper, in accordance with Rule 2 of the Technical Association's Regulations, is for the dissemination of technical knowledge; to convey and publicize information to all members of the Technical Staff.

The case should be briefly, clearly and logically presented, with relevant points suitably arranged, in an easily readable manner. Readers prefer to have the subject matter clearly stated and have not the time to wade through superfluous material. Experts and those less experienced, should be capable of understanding the whole argument.

2.2 Copyright and Security Clearance

Where applicable it is the author's responsibility to obtain the necessary rights and permissions to publish before the manuscript is submitted. Any copyrights involved should be suitably acknowledged in the paper.

2.3 Length and Style

Where practicable, the length of the paper should be limited to 5000 words, with about 15 illustrations maximum. When the subject matter is extensive, rather than pruning, consideration should be given to the division of the material for two or more separate papers, each complete in its own right. This would present the subject in a more acceptable, less voluminous manner, without the necessity to discard valuable information.

From time to time, conference type papers may be proposed by the Association, in which case authors would be requested to contribute, say, 4000 words with ten illustrations.

Consideration should be given to the use of figures, tables, graphs and illustrations to convey information in order to reduce the length of text.

As previously indicated no special style is expected of the author. He should, however, write in the third person in non-idiomatic non-esoteric language where possible.

2.4 Arrangement

2.4.1 Order

Papers are generally arranged in the following order:—

Title
Summary (Synopsis)
Table of Contents
Notation
Introduction
Main Text
Conclusions
Acknowledgements
References
Bibliography
Appendices
Glossary
Index

It should be understood that not all papers will have all the sections listed and it is for the author to decide which are to be omitted.

2.4.2 Headings and Sub-Headings

It is preferred that more emphasis be placed on the main headings than on the sub-headings. This can be done in two ways:—

(i) The heading of the main sections should be printed with bold capitals whilst those of the sub-sections should be in bold but with initial capital letters only. Further subdivisions being in normal fount with initial capitals.

(ii) A logical section numbering system should be used to emphasize the main sections.

The Author prefers the decimal system as indicated in this Guide, e.g. Section 2 MAIN TEXT, 2.4 Arrangement, 2.4.2 Headings and Sub-Headings. Other alternatives may be considered. The 'Rule Book' is divided into chapters (and subchapters) alphabetically (Chapter R(J)), Parts, Section and Paragraphs numerically with arabic numerals, clauses in lower case roman lettering ((a), (b), (c)), and subsidiary clauses in lower case roman numerals ((i), (ii), (iii)). Although easily understood, the system does not lend itself to comparatively simple technical papers.

2.4.3 Title

The title should be short and clear to indicate to the reader the subject under discussion. It should be chosen with care in order not to cause confusion with other papers.

The author should also state the port or office in which he works. This gives the paper a more personal touch.

2.4.4 Summary or Synopsis

Assuming the reader has some knowledge of the subject the purpose of the summary is to indicate, in 100 to 300 words, the general content of the paper including the conclusions. It should be comprehensible by itself without reference to the main text and should not be confused with the 'Introduction'.

The summary should precede the main text and is preferably positioned on the title page.

2.4.5 Table of Contents

Unless the papers are long, the Table of Contents is rarely published. It is of value, however, in the manuscript for referees and the Printing House staff.

2.4.6 **Notation**

It is possible that this section also, may not find its way into print but can be of considerable assistance to those refereeing or editing the paper. It should state clearly and concisely the definitions of all the symbols used throughout the paper.

It is preferable that only one symbol is chosen for a physical quantity, and this can be suitably modified by subscripts and superscripts. For example 'h' would be recommended for enthalpy giving:—

Enthalpy of saturated fluid	h_f	not h
Enthalpy of saturated gas	h_g	not H
Enthalpy difference	h_{fg}	not L
Other enthalpy differences	$h_{1,4}$ etc.	

The subscripts f and g are abbreviations and therefore appear in roman. Other appendages may be derivations from a physical quantity and these should be in italics, e.g. *v* for volume in c_v.

In listing the symbols, the meaning of all subscripts and superscripts should be clearly indicated by defining the basic symbol with and without appendage, or by defining the appendages.

Mathewson (1) has attempted to standardize nomenclature used in connection with ship structures and this may be considered when writing relevant papers.

Units are not generally quoted in this section.

NOTATION

ALTERNATIVE 1

d_i — inside diameter
d_o — outside diameter
p_a — absolute pressure
p_g — gauge pressure

NOTATION

ALTERNATIVE 2

d — diameter
p — pressure
Subscripts
a — absolute
g — gauge
i — inner
o — outer

2.4.7 **Introduction**

This section should not be incorporated with the summary but may be used to commence the main text. It should make known to the reader the background of the paper and should include, when appropriate, references to papers of a similar nature previously published. Unusual technical terms may be explained concisely at this point by way of introduction.

2.4.8 **Main Text**

The sub-sections of the main text should be presented in sequence, grouping together related material. The argument should be advanced in a logical step by step manner, each point being explained as it is presented, with any digressions being elaborated in an appendix, along with any extensive mathematical proofs, etc. The latter should only be included if absolutely essential to the paper.

Where footnotes are essential, they should be placed in the draft on the line immediately below their reference, separated from the text by lines above and below. They will, of course, appear in the paper at the foot of the page in 6 point type.

Reference should be made in the text to all figures, illustrations, tables, references, etc., their numbering being in group sequence as they appear in the text (Fig. 1, Fig. 2, Table 1, Table 2, etc.).

Advertising and long extracts from other printed material are not generally acceptable.

2.4.9 **Conclusions**

The conclusions should be used to bring the main text to a close. They should be logically presented from the arguments put forward in the main text, with the author's recommendations also stated.

2.4.10 **Acknowledgements**

If assistance has been given in the production of the paper, it should be suitably acknowledged. Reference made in this section to individual people, firms or other associations would not be considered as advertisement.

2.4.11 **References and Bibliography**

The value of these reference lists is two-fold: (i) the author can acknowledge works to which he has referred in the preparation of the paper and (ii) the reader is informed of further literature in the field.

Generally all references made in the paper are separately numbered using numerals in parenthesis and are listed in order of appearance. The name of the author and document should be listed along with the publisher and date of publication. The page and line numbers may also be given for further information provided it is clarified to which reprint it refers. The titles of foreign publications should not be translated.

If the number of references in the whole of the paper is less than, say, five, it will be acceptable to make use of footnotes.

Where references have more than two authors, only the first should be mentioned in the text, e.g. 'Simpson et al. suggest . . .', not 'Simpson, Bates and Beckwith suggest . . .'. It should be noted that initials and titles are not normally included included in the text.

Further sources of information not referred to in the text may be given under the heading Bibliography, with the author's surnames listed alphabetically. It is recommended that the only references made under this heading are those works readily available to the reader.

2.4.12 **Appendices**

Although the list of references and bibliography are appendices to the paper they are not to be referred to as such and the first following appendix should be listed as Appendix 1.

The material most suitably placed in the appendix is that which, if included in the main text, would interrupt the continuity. Long mathematical proofs, elaboration of side issues and detailed explanatory matter make typical appendices.

2.4.13 **Glossary**

This dictionary of special words is of great value to the non-specialist when reading the paper. Unless some reference is made to the glossary in the early part of the main text, however, its worth may be lost in that the reader may loose interest by not fully understanding the argument presented.

It is expedient to request a non-specialist to read the draft manuscript in order to confirm if the glossary is complete.

2.4.14 **Index**

The value of an index to a complex technical paper does not have to be emphasized when these publications are kept for reference purposes.

2.5 Spelling, Punctuation, Usage

2.5.1 Spelling

Any good dictionary may be used for checking spelling and standardization can be regarded as an editorial function. (It may be noted here that the 'z' spelling is preferred for words like standardization, galvanize, etc.) The author, however, should double check the accuracy of all names.

Distinction should clearly be made between the letters, I, O, x and one, zero and the multiplication sign.

2.5.2 Initial Capitals

The use of initial capitals is often abused. In general, if in doubt, the lower case should be used, e.g. the words 'after peak' should not warrant their use.

There is one case, however, where the initial capital could be recommended and that is in substitution for quotation marks where a word has two different senses, e.g. Figure, Table, etc. (The Author would also point out that in this paper the lower case has been used where referring to other authors.) Initial capitals and quotation marks, however, should not be used simultaneously for this purpose.

2.5.3 Quotation Marks

Single quotation marks should be used with double quotation marks indicating quotations within quotations. Omitted material is symbolized by full stops and interpolations are shown in square brackets.

Biblical, classical, slang and proverbial expressions do not require quotation marks, nor do technical terms in normal use. However, when a word is used in an unusual sense, quotation marks may be employed in the first instance only, provided there is no possibility of ambiguity. (This procedure may also be used when referring to trade names.)

2.5.4 The Comma

The comma should be used to make the text unambiguous. If its use is overmuch repeated, the sentence should be rephrased. Commas are not generally used before *and* and *or*. Similarly after *i.e.*, *e.g.* and *namely* it is also omitted.

2.5.5 The Hyphen and Solidus

The is no rule governing the use of the hyphen. The prefix non, for instance, generally takes a hyphen as in non-committal or non-conducting, but not in nonentity or nonsense. Examples, however, may be found in the dictionary.

The hyhen should always be used for clarity when using adjectives, adjectival nouns and nouns simultaneously in the same expression, e.g. a *cold water-drum* would indicate a water-drum that was cold not a drum for cold water; similarly *glass eye-bath* or *old engine-inspector.*

The hyphen may also be used to indicate range, e.g. 60–85 kg/cm^2 and in this case it should not be confused with the solidus which would indicate an alternative 60/85 kg/cm^2. When using both together, particular attention should be paid to avoid ambiguity (Copper/Copper-aluminium alloy).

2.5.6 Italics

Foreign words and words being defined to be printed in italics should be underlined with the marginal instructions ital. See Appendix 2.

2.5.7 Abbreviations and Unit Symbols

It is accepted that abbreviations may be used repeatedly in technical papers. They should, however, be spelled out in the first instance by the use of parenthesis.

The point is always used to indicate an abbreviation, e.g. dia., Figs., max., min., Ref., r.p.m., vol., wt., etc. Unit symbols are not considered as abbreviations and do not take the point or the plural 's'. e.g. m, cm, kg, j.

Basic units should be printed in full when not preceded by a numeral but multiples, sub multiples, powers of basic units and compound units should be abbreviated whether or not they are preceded by a numeral, e.g.: —

L is the length in metres,
. . . where h exceeds 1,7m,
L is the length in mm,
V is the volume in m^3,
L is the distance in km,
p is the pressure in N/mm^2.

Colloquial use of symbols is to be avoided, e.g. 'The r.p.m. of the turbine was 3500' makes bad reading.

2.6 Units and Numerals

2.6.1 Units

It is recommended that only the preferred SI units should be used, the set rules associated with them being followed to the letter. Much has been printed regarding the use of SI units but for completeness a copy of the L.R. leaflet 'Particulars of SI units applicable to the Society's Rules' has been included in Appendix 3.

In special cases it would be acceptable to use other units provided they were fully defined.

2.6.2 Numerals

It is surprising how numerals can be misleading. To avoid any misunderstanding the following facts should be pointed out: —

(i) the British comma on the line separating the thousand and hundred figures is a European decimal symbol, (British one thousand two hundred and sixty reads as European one point two six zero.)
(ii) a decimal point on the line is a European symbol separating the thousand and hundred figures (one point two six zero reads as European one thousand two hundred and sixty),
(iii) the British decimal point at half height is a European multiplication sign. (British one point two six zero reads as European one times two hundred and sixty.)

In order to avoid confusion the following are recommended: —

(i) Use the comma on the line for the decimal symbol.
(ii) Always have at least one digit before the decimal point (e.g. 0,246).
(iii) Large numbers, of more than four digits on one side of the decimal point, should be separated into groups of three as follows: —

1245,2 but 12 452,6 and 0,1245 but 0,124 56.

(iv) The multiplication sign, ×, should be omitted from equations.

Numerals at the beginning of sentences in text should be spelled out, and elsewhere except, (i) where over ten, (ii) where used for physical quantities, or (iii) general accepted practice (3-phase).

Numbers should be upright roman.

2.7 Mathematics

Lengthy mathematical material spoils the continuity of the paper and should be presented in an appendix. Mathematical statements and short operations, however, are acceptable and may be written in the text or displayed on separate lines. The solidus should only be used in textual equations, and to avoid ambiguity liberal use should be made of braces, brackets and parenthesis. See Fig. 1.

As explained above (2.6.2) the multiplication cross should be avoided, and braces, etc., are useful in this respect.

If many equations are used in the paper they should be numbered in sequence.

DISPLAYED	TEXTUAL
$\dfrac{a}{b}-c$	$(a/b)-c$
$\dfrac{a+b}{c}+\dfrac{c}{a}$	$[(a+b)/c]+c/a$
$\dfrac{a+b}{c-d}$	$(a+b)/(c-d)$
$\dfrac{a+b}{2\cos^2\theta+2}-c$	$\{(a+b)/(2\cos^2\theta+2)\}-c$

FIG. 1

Comparison of displayed and textural mathematics.

2.8 Type and Printing Instructions

The author should not generally be concerned with printing problems as this is an editorial function, but occasionally special instructions may be required. These should be written in ink in the margin with appropriate textual marks. B.S.1219 gives a complete list of proof correction symbols, but the author may wish to note those given in Appendix 2. Too many instructions, however, lead to confusion.

Greek lettering should be hand written and elucidated in the margin indicating whether upper or lower case. For convenience, these are given in Appendix 4.

Roman upright fount should be used for all chemical compounds, mathematical operators and, with exceptions, units but symbols for physical quantities should be italicized.

2.9 Typing and Dispatch

2.9.1 Guidance Notes for Typists

From the manuscript, which should be legibly written, the primary draft should be typed on good quality paper on one side only. It is preferable that at least two copies should be prepared for the Association, the author retaining a further copy for his own use.

Wide side and top margins are essential for editing notes and instructions, especially the top and L.H. margin which should be approximately 30 to 40 mm wide. Double spacing should be used to leave room for further corrections.

Any symbols to be hand written in ink (Greek, mathematical, etc.), should have ample space left for them.

Footnotes should be inserted in the text immediately below the line in which reference is made. They should, however, be separated from the text by horizontal lines above and below the footnote.

Pages may be numbered at the top right hand corner leaving the top left for fastening arrangements. Plain sheets of paper front and back will provide sufficient protection.

Tabulated material should be typed on separate sheets and inserted in the text close to their references. Illustrated matter should, however, be kept separate from the draft to be forwarded to the Technical Illustrators. These points are further elaborated in Section 3.

2.9.2 Dispatch

Before submitting the draft to the Honorary Secretary, the author should check his text and illustrated matter. Minor alterations or corrections are acceptable at this stage but more substantially amended areas should be retyped. (Consideration could be given to 'cut and stick' provided the end result is adequate.)

Corrections to the draft should be by erasure and re-writing in ink. Corrections as per B.S.1219 by the author at this stage could be confusing to those editing or refereeing the paper and the practice is not encouraged.

For special instructions regarding illustrated material. See Section 3.

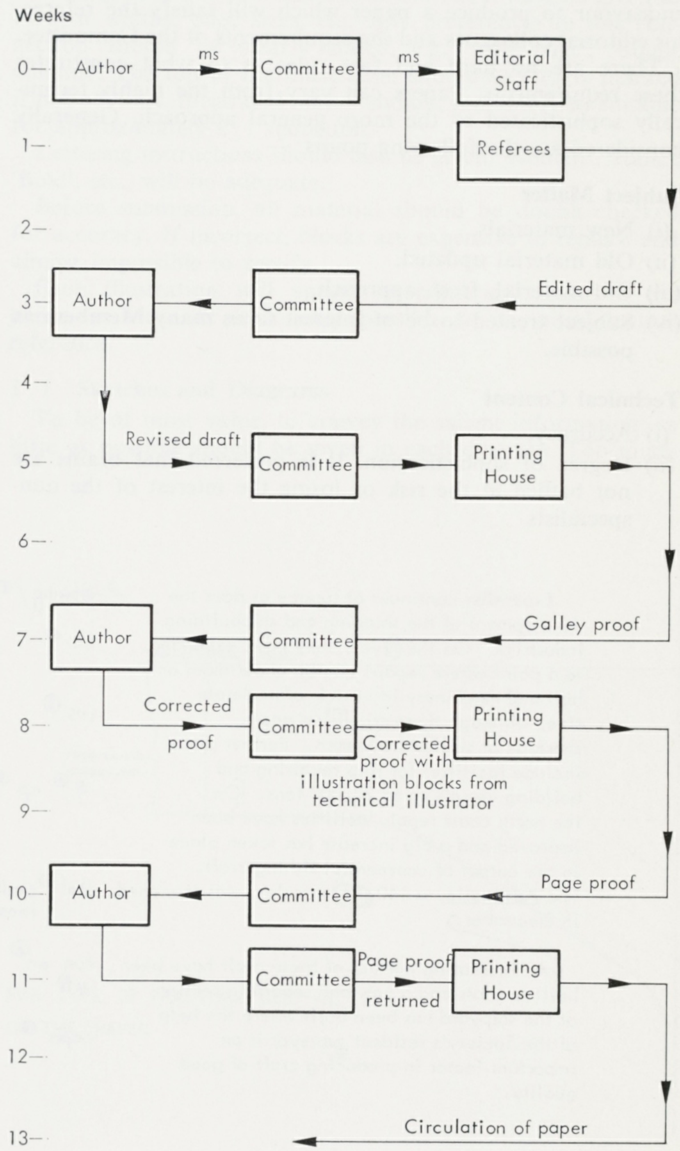

FIG. 2

The history of the paper before the meeting.

Fig. 2 gives an indication of the history of a paper before the meeting but a reasonable amount of time should be allowed in order that the work may be fitted into the schedule of the Printing House and to allow the Technical Illustrator time to complete his work programme.

2.10 Consideration of the Draft

Following submission to the Honorary Secretary, drafts should be suitably refereed and edited before they are sent for printing, ideally that no amendment would be required at the galley proof or page proof stage. Amendments after going to print are time-consuming, frustrating and expensive.

The referee will give consideration to the paper and comment as indicated in Appendix 5. At the same time the paper will be examined editorially, minor amendments being made to place it in a more acceptable form with regard to standard spelling, punctuation, etc.—not for technical accuracy. These functions should be anticipated by the author who should endeavour to produce a paper which will satisfy the referee, his editorial colleagues and the requirements of the Committee.

There are no hard and fast rules as to what constitutes these requirements. Papers can vary from the highly technically sophisticated to the more general approach. Generally considered are the following points:—

Subject Matter

(i) New materials,
(ii) Old material updated,
(iii) Old material, fresh approach,
(iv) Subject treated to be of interest to as many Members as possible.

Technical Content

(i) Accuracy,
(ii) Degree of sophistication. It is preferred that brains are not baffled at the risk of losing the interest of the non-specialists

Approach

(i) Subject to be treated in an acceptable manner—clarity, brevity, layout,
(ii) Conclusions to be reasonable and logical,
(iii) Paper to be acceptable without deletion or additional material,
(iv) Humour.

On the point of humour it is safer if it is avoided in print. Internationally what is one man's meat is another man's poison. Unintentional offence can easily be given and shipowners, builders, repairers, underwriters, etc., may have the opportunity to read a reprint of the paper at a later date. The place for humour is in the auditorium.

2.11 Printing the Paper

It is not intended to go into detail on this point as this procedure has been covered elsewhere, (2). It is sufficient to indicate that Fig. 2 gives indications of the function of the Printing House.

Authors should be reminded however that modifications to blocks, galley or page proofs are expensive. Proofs sent to the author should be examined for printing errors only and opportunity should not be taken to modify the text further. Corrections to the proofs should be made in ink and any problems that have arisen should be settled at this time. On checking the proof, it should be returned to the Honorary Secretary suitably initialled on the cover.

The author should satisfy himself that the pulls of illustrations are acceptable in particular that the reference numbers are correct. If a discrepancy, which is not incorrect, is discovered in a pull-off, it may be cheaper to modify the text rather than change the block.

Proofs should be corrected in accordance with B.S.1219(c) and should be returned as early as possible. If the author is in the London Office, return would be expected within two or three days.

Fig. 3 gives an indication of how proofs are corrected.

Expansion continues at a pace as does the development of the shipping and shipbuilding industries. On the River, they have expanded to a point where repairs can be undertaken on hull and machinery in vessels of moderate size, although there still is an acute shortage of skilled tradesmen. Further plans include facilities for ship repairing and building vessels up to 20,000 tons. On the north coast repair facilities have been improved and a big increase has taken place in the output of commercial fishing craft. The Pahamatic, a 140 g.t. trawler, was launched in December.

An increasing number of these craft have been built to class and a new and separate section of the shipyard has been built where the help of the Society's resident surveyor is an important factor in producing craft of good quality.

growing / ①
l.c. ②
trs ③
④ np ⑤
ital ⑥ spell out tons gross ⑦
run on ⑧
⑨
caps ⑩

1. Word 'growing' to be inserted.
2. Capital 'R' to be replaced by lower case 'r'.
3. Words to be transposed to read 'is still'.
4. Comma to be deleted to read 20 000.
5. New paragraph required
6. Name of vessel to be printed in italics.
7. The abbreviation g.t. to be printed in full, but as 'tons gross' and 'gross tons', in this instance.
8. Text to continue without a new paragraph.
9. Letter 'r' to be deleted and remaining letters to be closed up.
10. Lower case 's' to be replaced by capital 'S'.

Fig. 3

Proof correction.

3 ILLUSTRATIONS

Although clearly inter-related with the text of a paper, illustrations are afforded separate treatment for two reasons: —

(i) They are physically separated from the text from the time the author dispatches them until the printer inserts the blocks in the page proofs,

(ii) Receiving individual treatment the timing differs from the typewritten draft. (See Fig. 4.)

Illustrations are handled by the Technical Illustrator to Lloyd's Register of Shipping. As the submitted draft has to be fitted into the work programme of the Printing House, so must any illustrated material requirements be arranged to suit the schedules of the Technical Illustrators Department. It cannot be emphasized enough, how important it is to have details of figures, tables, plates, etc., forwarded at an early date even before the draft has been submitted. Delays in drawing or blockmaking lead to delays in printing and circulating the paper.

Only material essential to the paper should be included and full use made of the illustrations to reduce the volume of text. Each illustration should be clearly marked with, say, the author's initials and reference number, e.g. 'C.C. Tab. 4'. A separate sheet listing the titles should be enclosed to identify the illustrations in their groups, Figures (which includes photographs), Tables, etc., with consecutive numbering in accordance with their reference in the text. Brief captions should be added and any associated explanatory notes should be written therewith as a continuous statement not as an odd unconnected comment. (N.B.—Captions and notes do not concern the Technical Illustrator. Such details should be typed on a separate sheet and attached to the end of manuscript.)

In preparing the material, considerations should be given to column widths, page sizes, etc. Any preferences in this connection should be clearly stated, e.g. 'Full page', 'Single column'. The top of the illustration should be clearly marked if not obvious. Illustrated matter should, preferably be suitable for approximately 2 : 1 reduction.

Lettering instructions should also be given. 'Roman', 'Italic', 'Bold', etc., will be adequate.

Before submission, all material should be double-checked for accuracy. If incorrect, blocks are expensive to replace and almost impossible to rectify.

Each illustration will appear in numerical order in the paper, as close as reasonably possible to its initial textual reference.

3 . 1 Sketches and Diagrams

To be of most value, to convey the salient information, as little as possible should be given in each diagram. Too much

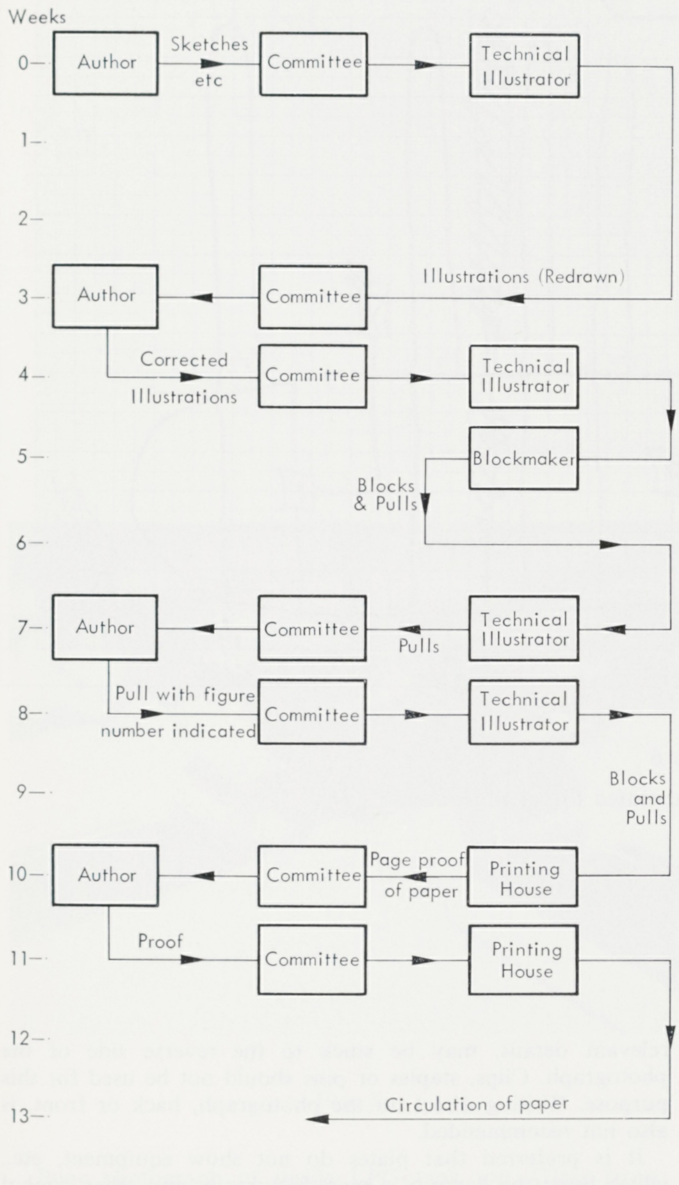

FIG. 4

History of the illustrations before the meeting.

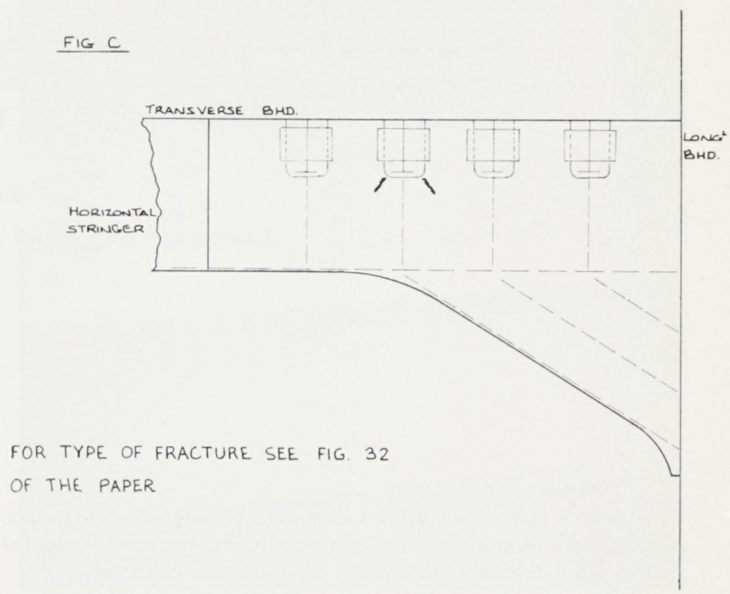

FIG. 5

Example of good sketch submitted to the Illustrator.

irrelevant detail masks the important features which should be made conspicuous.

Clear freehand sketches are acceptable. All unessential data should be omitted as elaborate detail does not lend itself to clear reproduction. Dimensions and dimension lines should never be included unless absolutely necessary; consideration could be given to the use of a scale if the impression of size is required to be conveyed.

Simple diagrammatics are preferred to 'working' drawings. If only such plans are available, a sketch should be enclosed to show how much (or how little) is required with projection arrows clearly indicating the pertinent views.

See Figs. 5, 6 and 7.

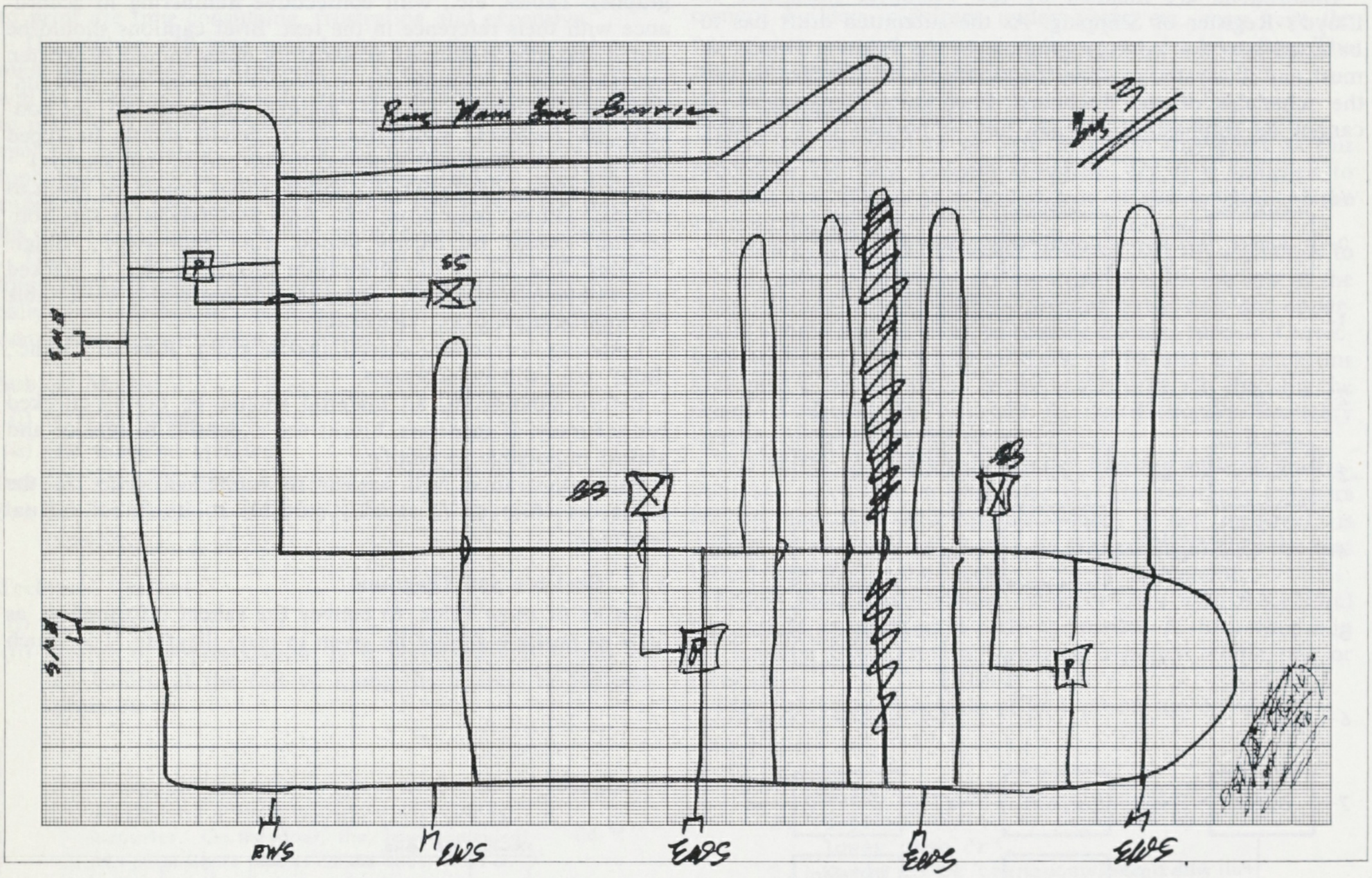

FIG. 6

Example of poor sketch submitted to the Illustrator.

3.2 **Plates**

Authors sometimes submit excessive photographic material. Only that essential to the text should be included. General views of machinery, shipyards, etc., are not expected.

Prints suitable for half tone reproduction should be clear, glossy contrasting black and white. Copies of existing half tone reproductions are not acceptable.

By way of identification, a slip of paper recording the relevant details, may be stuck to the reverse side of the photograph. Clips, staples or pins should not be used for this purpose. Writing direct on the photograph, back or front, is also not recommended.

It is preferred that plates do not show equipment, etc., which bears the name of a manufacturer or any other symbol which could be constituted as advertising.

See Figs. 8, 9 and 10.

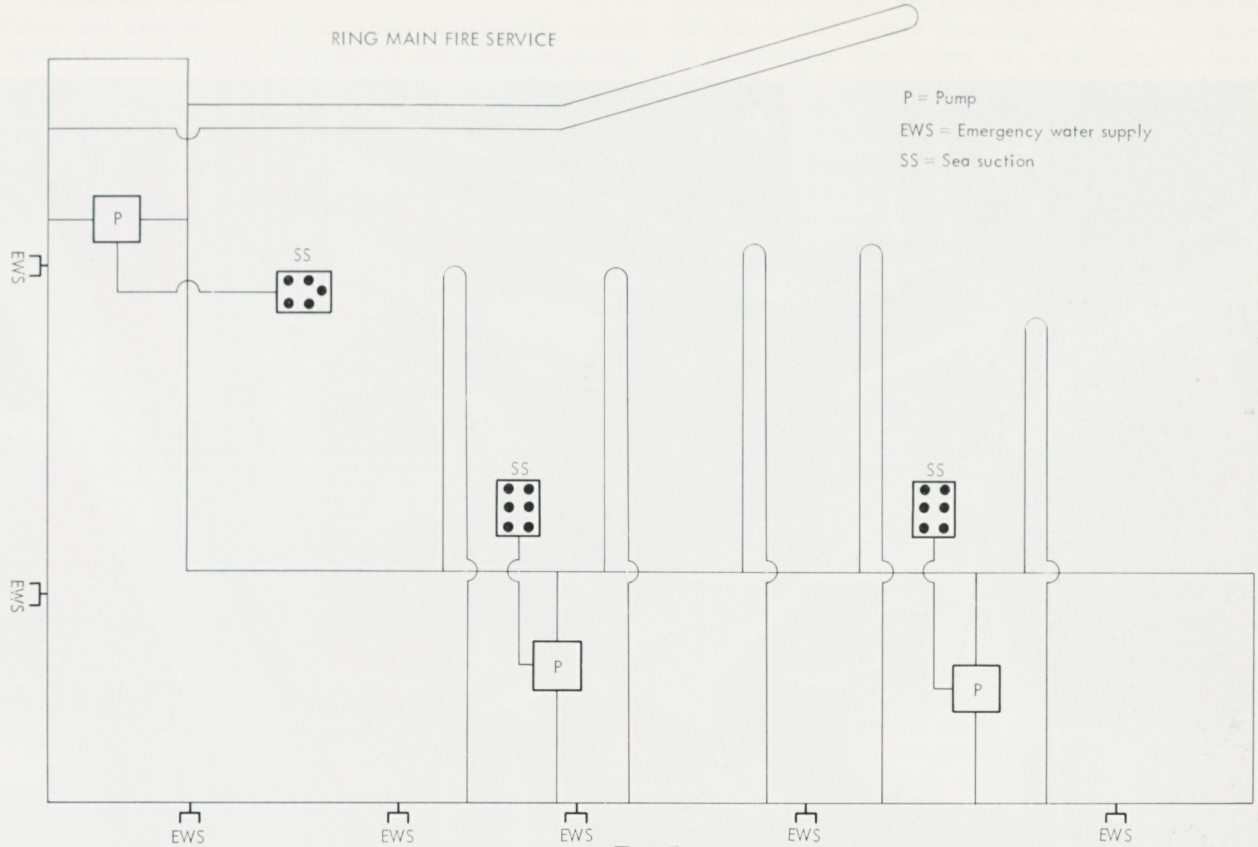

FIG. 7

Illustration produced from sketch (Fig. 6).

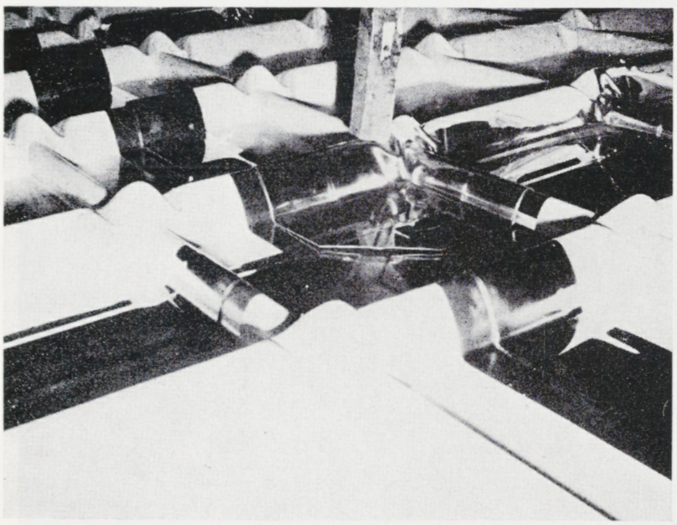

FIG. 8

Poor photograph of inside LPG tank top. Glare from polythene sheeting appears as a tank opening. N.B. This photograph has been deliberately printed up-side-down.

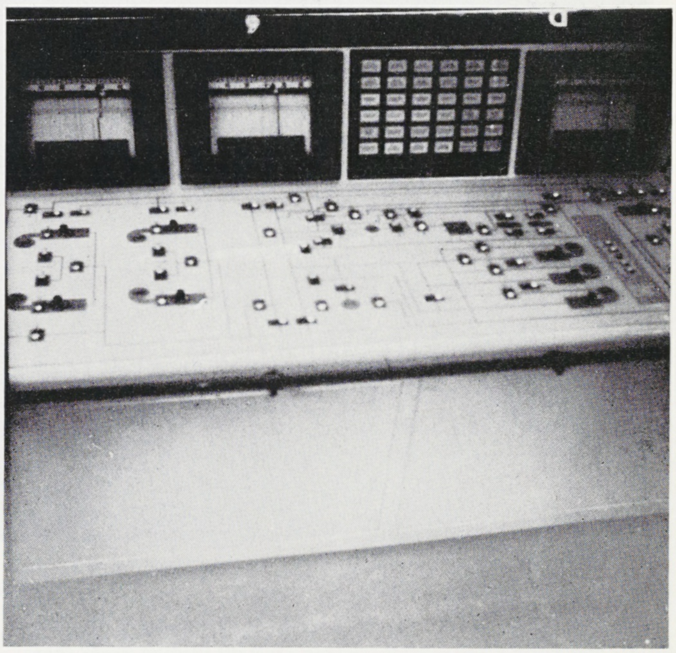

FIG. 9

Poor photograph. Subject out of focus.

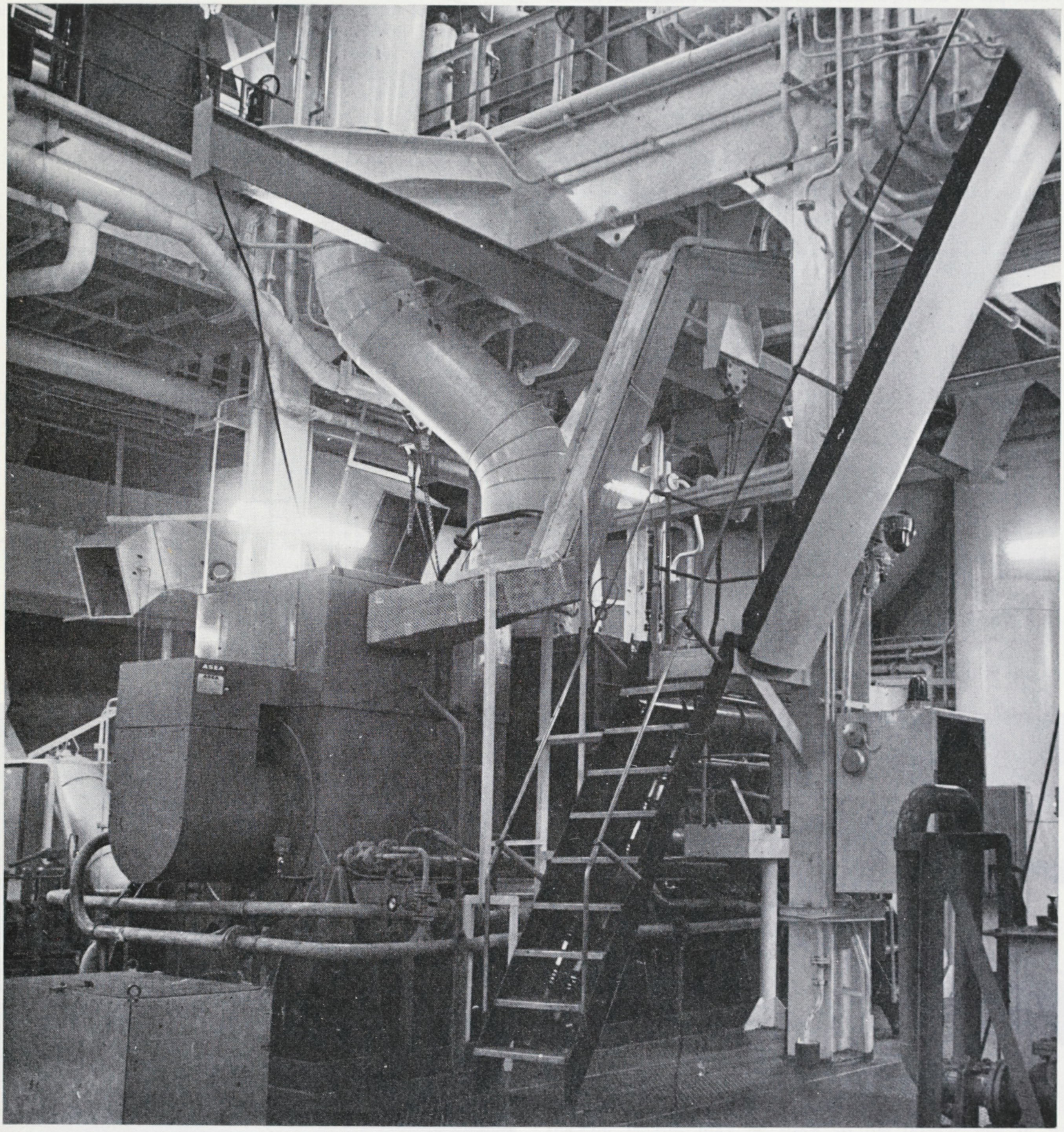

Fig. 10

Good photograph taken under difficult conditions.

3.3 **Tables and Graphs**

Tables are expensive to produce and consequently should be reduced to a minimum. They should not duplicate graphic or textual matter.

Figures given in table columns or on graph axes should be, if possible, pure numbers and kept to a reasonable size by the appropriate appendage of '$\times 10_n$' at the column heading or co-ordinate as applicable. See Table 1 and Fig. 11. All units should be indicated.

TABLE 1

Temperature	E_t	R_{20}	S_R
°C	kg/cm²	kg/cm²	kg/cm²
	$\times 10^2$	$\times 10^2$	$\times 10^2$
100	25	47	
200	22	47	
300	19	47	
400	16	47	12
500	13	47	3

Original curves on graph paper would have to be redrawn to be suitable for block-making. Scale and curve captions should be brief.

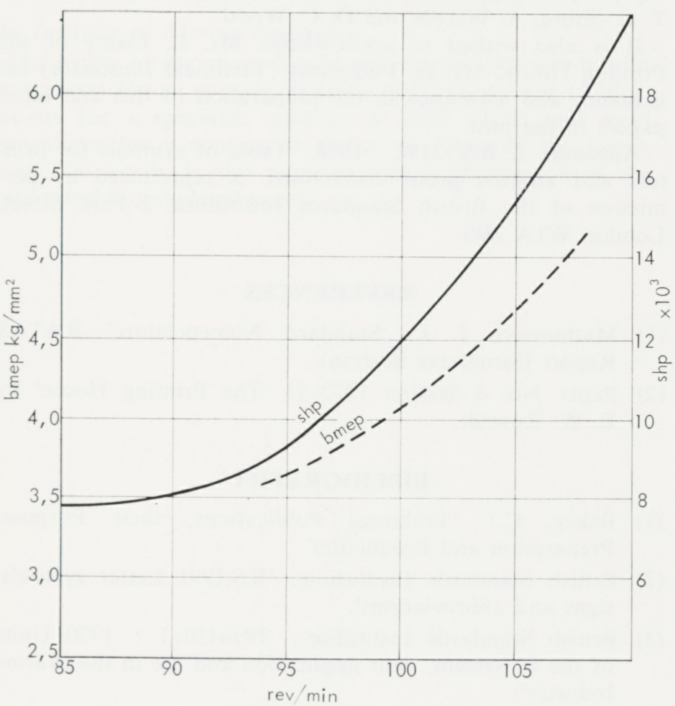

FIG. 11

Typical graph.

4 ORAL PRESENTATION

4.1 **General**

As it can be assumed that Members will have taken the opportunity to study the paper before the meeting. only 15 to 20 minutes need be spent on the verbal presentation. Two acceptable methods are (a) a general summary of the paper and (b) a brief lecture regarding the paper, but independent of its contents. The former, (a), should present logically the sequence of the argument including the main objectives and conclusions, while (b) may add background and information which has not been stated in the paper.

After the discussion by the audience, the author is expected to make a short reply, bearing in mind that a more complete reply may be made in the printed 'Discussions and Author's Replies'.

Full use may be made of the facilities available which include a 16 mm cine projector, a 2 in slide projector and a porta-scribe overhead projector. (See section 4.4—Lantern Slides). The sequence of presentation of visual aids should be carefully considered in order to build up a picture gradually, to maintain the attention of the audience and stimulate the discussion.

4.2 **Preparation**

It is well recommended that the author should rehearse the presentation as fully as possible in order to gauge its length, bearing in mind the visual material also to be used. A good length of script would be, say, 1500 words,, delivered at 100 words per minute, with an additional allowance of one minute per slide. A slow speaking rate has a soporific effect on the audience, whilst a too fast delivery becomes incomprehensible.

To be effective, the speech should be reduced by dicarding all superfiuous material, giving due consideration to the audience (technical, non-technical, etc.).

To prepare the speech thoroughly, the material, including visual aids, should be collected from all available sources to produce a good selection for the final preparation. A word-for-word script could be prepared to cover all the material to be used, but this should not be used for the delivery. Speeches are better spoken than read, so for the presentation a list of brief headings is useful for ready consultation, without losing the attention of the audience.

Set pieces should be avoided in order to adopt a normal conversational manner. Similarly, funny stories should not be resorted to unless the audience is known to the author and he is particularly capable in this respect.

A useful way in which to put over an argument is by illustrating the problem with an example, bringing out the salient points and finally, giving the reasoning behind the proposals.

4.3 **Delivery**

Audiences like speakers to be natural. If something does not ring true, it will be treated with suspicion. Speaking is difficult enough without having to act at the same time. Self image is unimportant. It is the subject under examination, not the speaker.

Speaking can, of course, be practiced in private and this is well recommended. Tongue twisters with exaggerated mouth and lip movements are helpful, as well as the usual m's, n's, p's, b's, etc., spoken through the mouth and nose.

Although it is admitted that the audience gives the speaker several minutes grace to settle down, long rambling openings are to be avoided. Twenty minutes is not very long and it should be used to the best advantage.

The voice should be only slightly higher than conversational. This is not only to ensure that all can hear but also helps with the diction. A colloquial style is easier to listen to than pure English.

Consideration should be given to the audience and its attention maintained by painting verbal pictures. Stimulation is preferred to aggravation, so, in order to introduce controversial material it may be better to start: 'It has been suggested . . .', thus leading to an active well balanced (it is hoped) discussion.

If a comfortable, relaxed stance is adopted the hands and arms will take care of themselves. Callisthenics, although well recommended before the meeting to overcome 'nerves', are distracting to the audience, as are other theatrical exercises such as cliff hanging, stage pacing, etc. Normality is all that is expected.

4.4 Lantern Slides

It is recommended that, well in advance of the meeting, the services and advice of the Technical Illustrator should be sought in order to obtain a more satisfactory end product. This will ensure that the correct size of print, etc., is used, due consideration being given to the magnification.

If insufficient time is allowed for the preparation of the slides by a professional, the author himself may have to prepare what is required. A reasonable result may be obtained if care is taken, particularly regarding the figures and printing. The use of coloured lines and/or shading is pleasing to the eye and may make the point more obvious.

To obtain the best results, only a little information should be included on each slide. As for illustrations, too much detail masks the important features. If more information has to be included, it could be spread over a series of slides to be presented in sequence.

For more complicated illustrations, a special slide may be prepared for the porta-scribe overhead projector, using very faint, fine lines which would be visible to the speaker but not very clear to the audience. During the verbal presentation, the lines can be heavily overdrawn for added interest and to build up a logical argument. A similar result can be obtained if time is short, by using supplementary slides to overlay the the basic illustration.

All slides should be sequencially numbered in order of presentation. This helps the operator in the projection room and aids the speaker with his larger slides in hand.

4.5 Author's Replies to Discussions

The main difference for the author between the presentation of the paper and the authors replies is that no time is available for preparation. Notes should therefore be made of the questions and comments made during the verbal discussions (with the contributor's name recorded), for ready reference during the reply. No attempt should be made to write down any answers, for in doing so the remaining comments made by the contributor will be missed. The replies to the points raised may be on a simple point-by-point basis, or more general, covering several related comments at the same time.

It should be borne in mind that only a brief reply need be made by the author to the contributors comments if a more comprehensive reply is to be made in the written discussions. It reflects adversely on the author, however, if once promised, the written reply is not produced.

5 CONCLUSIONS

If this paper can draw to the attention of future authors some of the problems in the preparation of technical papers without discouraging them from putting pen to paper, then the exercise in its writing will have been worthwhile. Anticipation of these pitfalls by the author, will expedite the publication of the papers in that less editing will be required.

For the author, the pitfalls are manifold. Incorrect grammar, punctuation, abbreviations, symbols and units, technical terminology and spelling are the most numerous. On rereading, certain passages may appear to be ambiguous or obscure. These should be rephrased, bearing in mind the cosmopolitan membership of the Association. Redundant clauses should be deleted and those which could be misconstrued, considered as advertisement or are of doubtful taste should be re-examined and rephrased.

It is hoped that the contents of this paper will be of value to authors of all papers whether or not they are intended for Lloyd's Register Technical Association. 'Staff Association' papers, from time to time over the years, have been accepted by the senior institutions for presentation, to the mutual benefit of the author and the marine industry in general. The Index to the Transactions lists many authors who have distinguished themselves in this and other fields. How many more are yet to come?

ACKNOWLEDGEMENTS

The preparation of this paper developed from groundwork carried out by a small working party of the Committee of Lloyd's Register Technical Association. The Author wishes to express thanks and appreciation to the Members of that working party namely Messrs. J. D. Bolding, K. M. B. Donald, T. E. Shore, A. Wardle and D. C. Wood.

It is also wished to acknowledge Mr. L. Ewing of the Printing House, Mr. G. Pumphrey (Technical Illustrator) for guidance and assistance in the preparation of this and other papers in the past.

Appendix 2, B.S.1219C: 1958: Table of symbols for printers and authors proof corrections, is reproduced by permission of the British Standards Institution, 2 Park Street, London W1A 2BS.

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APPENDIX 1

Some Comments on Engineering Institution Requirements

When writing a technical paper for a technical institution the author should fully acquaint himself with the up-to-date requirements of the body concerned. These requirements vary from time to time and changes have been made in recent years when economy has been one of the prime concerns.

A draft prepared in accordance with the comments given in the foregoing paper would be considered generally acceptable for an institution. It should be borne in mind, however, that the readers will most likely be British. Hence the decimal point (·), the multiplication sign (×) and 's' spellings may all be quite acceptable, with the Concise Oxford or Oxford English Dictionaries recommended.

It can be expected that two or more referees will be requested to read the draft, each reporting independently to the Papers Committee of the institution. Their comments will then be taken into consideration before the paper is accepted or rejected.

When the paper is accepted and printed, copyright normally passes to the institute unless another prior claim is involved. The author, however, upon request, would generally be granted use of the copyright subject to a suitable acknowledgement also being published in the paper.

Other points worthy of mention are as follows:—

The Institute of Marine Engineers

The length of the paper should not exceed 8000 words with illustrations for an evening meeting, 6000 words and 15 illustrations for a specialist meeting or 4500 words and eight illustrations for a conference paper. A precis of the paper, about 600 words, is also required with a photograph of the author and biographical notes.

Four copies of the text should be submitted four months before the scheduled meeting along with the illustrations—one set of unlettered tracings and three sets of lettered prints.

The Royal Institution of Naval Architects

The Institution prefers the nomenclature and symbols approved by the International Towing Tank Conference but recommends additional symbols regarding strength and vibration. Authors should request a copy of the 'approved' list as they would be expected to conform with the abbreviations and symbols.

As the Institution uses the Uneoprint system, the papers are not edited or styled in any way by the machine operator.

The Institution of Mechanical Engineers

The length of the paper should not exceed 5000 words with eight illustrations. The decimal point (·) is expected with numerals in groups of three before and after, without the use of commas.

Regarding illustrations, ink drawings with pencilled lettering (including captions) are expected with consideration being given to column and page widths.

The Institution of Electrical Engineers

The length of the paper should not exceed eight pages—about 6000 words with illustrations.

The author should state his place of employment on the title page, and should also include details of any information previously published in the subject under consideration.

Three sets of illustrations are required with pencilled lettering, suitable for page and column widths.

APPENDIX 2

BRITISH STANDARD 1219C: 1958

UDC 655.255.1: 003.62

TABLE OF SYMBOLS FOR PROOF CORRECTION

(Extracted from B.S. 1219 : 1958)

NOTES ON THE USE OF SYMBOLS FOR CORRECTING PROOFS

All corrections should be distinct and made in ink in the margins; marks made in the text should be those indicating the place to which the correction refers.

Where several corrections occur in one line, they should be divided between the left and right margins, the order being from left to right in both margins, and the individual marks should be separated by a concluding mark.

When an alteration is desired in a character, word or words, the existing character, word or words should be struck through, and the character to be substituted written in the margin followed by a /.

Where it is desired to change one character only to a capital letter, the word ' cap ' should be written in the margin. Where, however, it is desired to change more than one character, or a word or words, in a particular line to capitals, then one marginal reference, ' caps ', should suffice, with the appropriate symbols made in the text as required.

Three periods or full stops (constituting an ellipsis, see No. 61) should be used to indicate an omission, except where the preceding sentence has been concluded, in which case *four* full stops should be inserted, the first of which should be close up to the preceding word.

Normally, only matter actually to be inserted or added to the existing text should be written on the proof. If, however, any comments or instructions are written on the proof, they should be encircled, and preceded by the word <u>PRINTER</u> (in capitals and underlined).

(Words printed in italics in the marginal marks column below are instructions and not part of the marks).

SYMBOLS FOR CORRECTING PROOFS

No.	Instruction	Textual mark	Marginal mark
1	Correction is concluded	None	/
2	Insert in text the matter indicated in margin	⁁	*New matter followed by* /
3	Delete	Strike through characters to be deleted	
4	Delete and close up	Strike through characters to be deleted and use mark 21	
5	Leave as printed	. . . . under characters to remain	stet
6	Change to italic	——— under characters to be altered	ital

No.	Instruction	Textual mark	Marginal mark
7	Change to even small capitals	under characters to be altered	*s.c.*
8	Change to capital letters	under characters to be altered	*caps*
9	Use capital letters for initial letters and small capitals for rest of words	under initial letters and under the rest of the words	*c.&s.c.*
10	Change to bold type	under characters to be altered	*bold*
11	Change to lower case	Encircle characters to be altered	*l.c*
12	Change to roman type	Encircle characters to be altered	*rom*
13	Wrong fount. Replace by letter of correct fount	Encircle character to be altered	*w.f.*
14	Invert type	Encircle character to be altered	9
15	Change damaged character(s)	Encircle character(s) to be altered	X
16	Substitute or insert character(s) under which this mark is placed, in 'superior' position	/ through character or ⋏ where required	*under character* (e.g. x)
17	Substitute or insert character(s) over which this mark is placed, in 'inferior' position	/ through character or ⋏ where required	⋀ *over character* (e.g. x)
18	Underline word or words	——— under words affected	*underline*
19	Use ligature (e.g. ﬃ) or diphthong (e.g. œ)	enclosing letters to be altered	*enclosing ligature or diphthong required*

No.	Instruction	Textual mark	Marginal mark
20	Substitute separate letters for ligature or diphthong	/ through ligature or diphthong to be altered	*write out separate letters followed by* /
21	Close up—delete space between characters	linking characters	
22	Insert space*	⋏	#
23	Insert space between lines or paragraphs*	> between lines to be spaced	#
24	Reduce space between lines*	(connecting lines to be closed up	*less #*
25	Make space appear equal between words	| between words	*eq #*
26	Reduce space between words*	| between words	*less #*
27	Add space between letters*	////// between tops of letters requiring space	*letter #*
28	Transpose	between characters or words, numbered when necessary	*trs*
29	Place in centre of line	Indicate position with ┌ ┐	*centre*
30	Indent one em		□
31	Indent two ems		□□
32	Move matter to right	at left side of group to be moved	
33	Move matter to left	at right side of group to be moved	

* Amount of space and/or length of re-spaced line may be indicated.

No.	Instruction	Textual mark	Marginal mark
34	Move matter to position indicated	[ ] at limits of required position	move
35	Take over character(s) or line to next line, column or page	[	take over
36	Take back character(s) or line to previous line, column or page	]	take back
37	Raise lines*	over lines to be moved; under lines to be moved	raise
38	Lower lines*	over lines to be moved; under lines to be moved	lower
39	Correct the vertical alignment	||	||
40	Straighten lines	═ through lines to be straightened	═
41	Push down space	Encircle space affected	⊥
42	Begin a new paragraph	[before first word of new paragraph	n.p.
43	No fresh paragraph here	between paragraphs	run on
44	Spell out the abbreviation or figure in full	Encircle words or figures to be altered	spell out
45	Insert omitted portion of copy NOTE. The relevant section of the copy should be returned with the proof, the omitted portion being clearly indicated.	⅄	out see copy
46	Substitute or insert comma	/ through character or ⅄ where required	,/
47	Substitute or insert semi-colon	/ through character or ⅄ where required	;/

* Amount of space and/or length of line may be included.

No.	Instruction	Textual mark	Marginal mark
48	Substitute or insert full stop	/ through character or ⅄ where required	⊙
49	Substitute or insert colon	/ through character or ⅄ where required	(:)
50	Substitute or insert interrogation mark	/ through character or ⅄ where required	?/
51	Substitute or insert exclamation mark	/ through character or ⅄ where required	!/
52	Insert parentheses	⅄ or ⅄ ⅄	(/)/
53	Insert (square) brackets	⅄ or ⅄ ⅄	[/]/
54	Insert hyphen	⅄	|-|
55	Insert en (half-em) rule	⅄	en
56	Insert one-em rule	⅄	em
57	Insert two-em rule	⅄	2 em
58	Insert apostrophe	⅄	’/
59	Insert single quotation marks	⅄ or ⅄ ⅄	‘/ ’/
60	Insert double quotation marks	⅄ or ⅄ ⅄	“/ ”/
61	Insert ellipsis*	⅄	.../
62	Insert leader	⅄	(···)
63	Insert shilling stroke	⅄	(/)
64	Refer to appropriate authority anything of doubtful accuracy	Encircle words, etc. affected	(?)

* See notes on use of symbols.

For examples of the use of these marks see B.S. 1219.

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LLOYD'S REGISTER OF SHIPPING

PARTICULARS OF SI UNITS APPLICABLE TO THE SOCIETY'S RULES

THESE TABLES HAVE BEEN PREPARED TO PROVIDE INFORMATION ON SI UNITS PRIOR TO THE INCLUSION OF SUCH UNITS IN THE SOCIETY'S RULES

BASE-UNITS

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogramme	kg
Time	second	s
Electric current	ampere	A
Thermo-dynamic temperature	kelvin	K
Luminous intensity	candela	cd

DERIVED SI UNITS

Quantity	SI unit	Symbol	Derived unit
Frequency	hertz	Hz	$1\ Hz = s^{-1}$
Force	newton	N	$1\ N = 1\ kgm/s^2$
Work, Energy, Quantity of Heat	joule	J	1 J = 1 Nm
Power	watt	W	1 W = 1 J/s
Electric potential, Potential difference, Tension, Electromotive force	volt	V	1 V = 1 W/A
Electric capacitance	farad	F	1 F = 1 As/V
Electric resistance	ohm	Ω	1 Ω = 1 V/A
Inductance	henry	H	1 H = 1 Vs/A

MULTIPLES AND SUB-MULTIPLES

Multiplication factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ

SI UNITS AND A SELECTION OF ISO RECOMMENDED DECIMAL MULTIPLES AND SUB-MULTIPLES OF THE SI UNITS TOGETHER WITH OTHER UNITS OR OTHER NAMES OF UNITS WHICH MAY BE USED					
Quantity	**SI unit**	**Selection of recommended decimal multiples and sub-multiples of SI units**	**Other decimal multiples and sub-multiples of SI units**	**Other units or names of units which may be used**	**Remarks**
SPACE AND TIME					
plane angle	rad (radian)	mrad		degree (...°) minute (...′) second (...″)	$1° = \frac{\pi}{180}$ rad
length	m (metre)	mm	dm cm	*International nautical mile (1 n mile = 1852m)	1 UK nautical mile = 1853,2m 1 fathom = 1,83m
area	m^2	mm^2	dm^2 cm^2		
volume	m^3	mm^3	dm^3 cm^3	litre (l)	$1\ l = 10^{-3}\ m^3$
time	s (second)	ks ms		day (d) hour (h) minute (min)	
angular velocity	rad/s				
velocity	m/s			*knot (kn) (1 kn = 1 n mile/h)	
*Unit may be used in UK but is not yet included in ISO Draft Recommendation on SI units					
PERIODIC AND RELATED PHENOMENA					
frequency	Hz (hertz)	kHz			
rotational frequency	s^{-1}			rev/min rev/s	

Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI units	Other decimal multiples and sub-multiples of SI units	Other units or names of units which may be used	Remarks
MECHANICS					
mass	kg (kilogramme)	Mg g		tonne (t)	1 t = 10^3 kg 1 UK ton = 1016 kg
density (mass density)	kg/m^3	Mg/m^3	1 kg/dm^3 = 1 g/cm^3	1 t/m^3 = 1 kg/l = 1 g/ml g/l	1 lb/ft^3 = 16,02 kg/m^3
moment of inertia	kg m^2				
force	N (newton)	MN kN mN	daN		1 lbf = 4,45 N 1 kgf = 9,81 N
moment of force	Nm	MNm kNm	daNm		1 lbf ft = 1,36 Nm 1 kgf m = 9,81 Nm
pressure and stress	N/m^2	GN/m^2 MN/m^2 kN/m^2	daN/mm^2 N/mm^2 N/cm^2	1 hbar = 10^7 N/m^2 1 bar = 10^5 N/m^2 1 mbar = 10^2 N/m^2 (pressure only)	1 lbf/in^2 = 6,89 kN/m^2 1 kgf/cm^2 = 98,1 kN/m^2
energy, work	J (joule)	GJ MJ kJ		kW h	1 kW h = 3,6 MJ 1 ft lbf = 1,36 J 1 kgf m = 9,81 J
power	W (watt)	GW MW kW			1 HP (metric) = 735,5W 1 HP (UK) = 745,7W
impact strength	J/m^2	kJ/m^2	daJ/cm^2 J/cm^2		
HEAT					
thermo-dynamic temperature	K (kelvin)				
celsius temperature				degree Celsius (°C)	
temperature interval	K			°C	1°C = 1 K
heat (quantity of heat)	J	GJ MJ kJ			1 Btu = 1,05 kJ 1 kcal = 4,19 kJ
heat flow rate	W	kW			1 Btu/h = 0,293 W 1 kcal/h = 1,16 W

Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI units	Other decimal multiples and sub-multiples of SI units	Other units or names of units which may be used	Remarks
ELECTRICITY AND MAGNETISM					
electric current (intensity of electric current)	A (ampere)	kA mA			
electric potential and potential difference, tension and electromotive force	V (volt)	kV mV			
capacitance	F (farad)	mF μF			
self inductance and mutual inductance	H (henry)	mH μH			
resistance	Ω (ohm)	MΩ kΩ mΩ			
impedance and modulus of impedance and reactance	Ω	MΩ kΩ mΩ			
active power	W	MW kW mW			

1971

APPENDIX 4

Greek alphabet		
	Upper case	Lower case
Alpha	A	α
Beta	B	β
Gamma	Γ	γ
Delta	Δ	δ (finite differences)
		∂ (partial differential coefficients)
Epsilon	E	ε
Zeta	Z	ζ
Eta	H	η
Theta	Θ	θ
Iota	I	ι
Kappa	K	κ
Lambda	Λ	λ
Mu	M	μ
Nu	N	ν
Xi	Ξ	ξ
Omicron	O	o
Pi	Π	π
Rho	P	ρ
Sigma	Σ	σ
Tau	T	τ
Upsilon	Y	υ
Phi	Φ	φ
Chi	X	χ
Psi	Ψ	ψ
Omega	Ω	ω

APPENDIX 5

Guidance Notes for Referees of Technical Papers Submitted

	Question	Comments
Subject	(1) Is the manuscript original or does it contain sufficient new material? (2) If lacking in originality or new material, has the paper other compensating qualities? (3) Is the paper (i) specialist paper, (ii) of general interest?	
Technical Content	(1) Is the technical content acceptable? (2) Is the technical standard acceptable? (3) Would any repetitious material (text, diagrams, illustrations, etc.) require to be deleted? (4) Would any further information make the paper more acceptable? (5) Are the conclusions logically reasonably and justifiably reached?	
Presentation	(1) Is the general presentation acceptable? Is it clear? Is it brief? Is the layout acceptable? (2) Are S.I. units used throughout? (3) Are all illustrations (drawings, tables, graphs, etc.) correctly referred to in text? (4) Are illustrations referred to in order (i.e. Fig. 1, Fig. 2, Fig. 3, and Table 1, Table 2, Table 3, etc.)? (5) Has the whole or part of the paper been presented before?	
Conclusions	(1) How acceptable is the paper for publication:— (i) without amendment? (ii) with amendment? (iii) not acceptable? (2) Is the manuscript recommended for (i) full Paper? (ii) Conference Paper? (iii) Discussion only? (3) Should be paper be presented at (i) H.Q.? (ii) H.Q. and elsewhere (if so state where)?	

GLOSSARY

(with some technical terms explained)

Blocks. Printed by letterpress from a raised surface, the non-printing surface being etched away by acid.

Block Pull. See 'Proof'.

Braces. Coupling mark } and {.

Bracket. Coupling mark [and].

Caption. Descriptive note beneath an illustration.

Casting Off. Counting the words in a manuscript to estimate the number of pages.

Composition. Type setting.

Copy. Original manuscript or typescript from which the type is set.

Copyright. Exclusive right to publish or sell copies of work for a certain period.

Draft. Preliminary document.

Em. The square of a piece of metal type on which a letter M would be cast. The width of a line as measured in ems.

Fount. Set of type.

Galley. A long tray into which new type is cast.

Galley Proof. Pulled from type in a galley tray in the form of a long sheet of paper.

Imposition. The positioning of type pages in the forme so that when the sheet is printed and folded the pages will read in correct sequence.

Landscape. Illustration printed 'sideways' to make best use of page.

Lithography. Printing from a flat surface, using the non-mixing properties of greasy ink and water.

Lower Case. Non-capital letters.

Make-up. Making up the galleys into page lengths.

Manuscript. (Ms) Handwritten text.

Parenthesis. Round brackets (and).

Point. Standard measure of size of type=1/72 in., i.e. 12 point. =1/6 in.

Proof. Trial impression taken from printing-type or engraved plate.

Pull-Off. See 'Proof'.

Script. Handwritten document.

Solidus. Oblique punctuation mark /.

Sub/Super-Script. Written below/above the line.

Text. The wording of a composition.

Transcript. Copy of document.

INDEX

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Lloyd's Register Technical Association

Discussion

on

Mr. C. Cummins' Paper

A BRIEF GUIDE TO THE PREPARATION AND PRESENTATION OF TECHNICAL PAPERS

Paper No. 3. Session 1973-74

Hon. Sec. A. Wardle
71, Fenchurch Street, London, EC3M 4BS

Discussion on Mr. C. Cummins' Paper

A BRIEF GUIDE TO THE PREPARATION AND PRESENTATION OF TECHNICAL PAPERS

MR. L. BECKWITH

When I saw the Technical Association programme for this session my first reaction was to question the reason for actually reading a paper such as this at a meeting of the Association. It is after all a reference paper, and would, in my opinion, have been more suited for circulation for written discussion only.

However, having said that, I must immediately add that although I still stand by my first reaction, the paper itself is one of high quality. Mr Cummins, in his capacity as Secretary of our Technical Association, is naturally anxious to encourage potential authors of papers for future sessions and, in producing this paper, I have no doubt he will have succeeded although it may be that some would-be authors may be overawed by the apparent magnitude of the task. I am sure that the task of many former authors would have been simplified had they had this paper by them when writing their papers and that it will be referred to in future by those preparing for external institutions.

There is no doubt that there is a considerable amount of work involved in preparing a technical paper. I would say that it could take anything up to a year and here we come up against the problem of time. This point was laboured considerably during the discussions on the 50th Anniversary paper 'Lloyd's Register Staff Association The Past and the Future' and there has certainly been no alleviation of the problem in the past two years. However, authors are still coming forward with papers and it is to be hoped that they will continue to do so.

As far as the contents of the paper are concerned, I can only agree with them. Mr. Cummins has followed his own recommendations when writing it and this has led to a good layout and ease of reference.

Mr. Cummins also followed his own recommendations when presenting the paper and in this respect I would suggest that the section of the paper headed ORAL PRESENTATION is applicable to contributors to the discussion as well as to authors. Wherever possible contributors should plan their remarks and not do as I have done tonight, scribble a few notes and hope for the best.

Unfortunately, however, in the case of Technical Association papers, for a variety of reasons we may not see the paper until the day before or even the day of presentation. Which emphasizes the need for authors to get material to the Printing House in time.

It is sometimes necessary to approach certain people to take part in the discussion and I would suggest that this be in good time so that they will have the opportunity the prepare their contributions and thus set the tone of the discussion. Authors could help here by arranging for advance copies of the paper to be forwarded to likely contributors. I would also suggest that it would enhance the paper if some additional notes for contributors could be included, giving guidance on length of contribution and how to go about it, etc.

With regard to the length of Technical Association papers I notice that the Author suggests 5000 words. In some cases it may not be possible to limit a paper to this size in view of the importance of conveying certain information. I am referring here to papers which are closely related to the Society's work, where to abridge may be false economy. The Author may have some comments to make on these points.

MR. R. A. DANIEL

When the Public Relations Department was invited to make a contribution to the discussion on this paper, I realised that the subject was one about which I knew rather little. For the writing of technical papers for presentation to learned bodies is a specialized activity and different in kind from the sort of work that my colleagues and I are used to.

In the first place, technical papers are written for a professional and more or less expert readership, whereas we in the P.R. Department are addressing a mixed and largely lay audience. Your papers are designed to be presented for discussion and, presumably, with the thought that they may be used subsequently as reference material; so the physical structure of a paper as outlined in paragraph 2.4.1, etc., is important. The material that the Public Relations Department produces is meant to be published in newspapers and magazines for which a formalized approach would be quite unsuitable.

It has been very interesting therefore to read Mr. Cummins' clearly written paper. I am sure that it will be gratefully received by his colleagues and I think he is to be congratulated on giving a pretty good demonstration of 'how to do it'.

A section which has drawn my attention particularly is that on spelling, punctuation and usage. The Author is absolutely right to give the space that he does to these matters—indeed, he might have given more—for the more an author can do to get the mechanics right the better, although this does not mean that the editor should relax his own vigilance over these matters.

One point on which I must take gentle issue with Mr. Cummins, however, is the use of hyphens. He says there is no rule governing the use of the hyphen. True, but it is possible at least to set out guiding principles for hyphenating. Some time ago, Mrs. Russell of the P.R. Department undertook a very thorough study which resulted in the compilation of a style manual. This was something for which we had found a growing need and it has been very helpful. One of the longer sections of Mrs. Russell's study dealt with the use of the hyphen, and it is quoted at the end of this contribution (*see Appendix D.2 to the Discussion*).

In the guidance note for typists, I was surprised to see that footnotes should be typed immediately under the line in which the reference occurs, with horizontal lines at top and bottom separating it from the rest of the text. I should have thought this would be troublesome for the printers, but I assume that the printers have expressed a preference for it.

I enjoyed the Author's section on oral presentation, which contains a number of useful hints, although I am not sure that I go all the way with him on the matter of delivery. 'Audiences like speakers to be natural', he says. 'If something does not ring true it will be treated with suspicion'. Absolutely. However, he goes on: 'Speaking is difficult enough

without having to act at the same time. Self image is unimportant. It is the subject under examination, not the speaker'. Now, I agree that the speaker should not act a part, but there might be dangers in being too completely natural. So many of us have mannerisms, both physical and verbal, that we may be unaware of but which could be intensely irritating and distracting to an audience.

So I would agree with the Author that it's a good idea for anyone who is not practised at speaking—and that goes for most of us—to do a little rehearsing beforehand. Try to see that you don't land yourself with a word that you have difficulty in pronouncing, or an awkward juxtaposition of consonants. Practising tongue-twisters may be alright in private, but it is better not to have to try it on the platform

The Author says 'A colloquial style is easier to listen to than pure English'. I trust he is not advocating the use of impure English at your meetings. Of course, we know what he means. Great oratory is out of place; what is needed is simple, direct, easily understood language, free of elaborate phrases or high-sounding words tossed in for effect.

The same considerations apply to the written word as well. The Author recommends the use of non-idiomatic non-esoteric language where possible. How right he is. Indeed, he could have driven the point home by adding, after his bibliography, recommended reading in the shape of 'Plain Words' by Sir Ernest Gowers.

Mr. Cummins is to be commended for producing a paper which, I imagine, will long remain an indispensable manual for colleagues facing authorship.

Mr. R. W. JAKEMAN

I think the Author has done us some disservice in misleading us by his choice of title for this paper. Although he has been most concise, it seems to me that rather than a brief guide, the paper will represent a comprehensive manual for prospective authors and editors for many years to come. However, despite its obvious excellence, I must take the Author up on a few detailed points.

In the section under the heading 'Purpose', the Author, in the interests of brevity, suggests that superfluous material should be avoided. The basic logic of this can hardly be questioned, but I think we must be careful in defining what is, and what is not, superfluous. A case history, for example, could be regarded as superfluous if the principle involved has been given a rigorous academic enunciation and if the validity was not dependent upon practical confirmation. But if the case history gave the reader a clearer understanding of the subject and perhaps also tended to promote interest, then I do not think that it should be regarded as superfluous. Another point in this connection is that the tendency for a paper to send the reader to sleep is far more dependent on its style than on its length. Whatever information we wish to convey we must remember that the reader is, after all, only human. Possibly the best illustration of all is the car brochure—can anybody here produce one which contains only a concise pure technical specification?

The Author also seems somewhat reticent on the subject of humour. I would agree with his comment that the oral presentation is a better place for humour than the written paper, but only insofar as humour tends to be more effective when presented live, and I would certainly not rule out the use of humour in the paper. Humour need not be frivolous, but may, as with the 'superfluous' material I have just discussed, be a valuable aid to communication. The best example of this was the lecture by Mr. Casson last year on 'effective speaking' in which humour, of a very high standard, pervaded the presentation from beginning to end. Can anyone claim to have fallen asleep on that occasion?—after all for at least some of our papers such a confession would be nothing to be ashamed of!

Under the heading 'Delivery' the Author tells us that in presenting the paper self image is unimportant. That sounds all very nice and proper, but in my view it doesn't correspond to reality. We all have our self images which we like to promote, although there may be a considerable variation in the consciousness and dedication with which we do it. There is the exception of the gentlemen who sleep out on the embankment, for whom the motivation for self image pushing may have faded. We, however, must not fool ourselves into thinking that our self image consciousness can be switched off at will. Fortunately the promotion of self image and presentation of a good paper are by no means incompatible, for anyone of reasonable intelligence will realise that if his paper is not thoroughly palatable to his audience, then it is hardly likely to do much for his self image. If any guidance in this area is required at all, it is simply in clarifying what constitutes a good paper.

Finally, in discussing the preparation for the oral presentation the Author recommends the use of brief headings in the notes as opposed to reading word for word from a fully prepared speech. For those who are well experienced and capable in this respect such a presentation is undoubtedly the better, but for we lesser mortals who do not claim such proficiency, the speech written word for word reduces what would otherwise be stark terror to a mild attack of butterflies in the tum!

Having said all that, I still think this is a jolly good paper, and since the Lloyd's Register Surveyor has had such a god-like image for so many years the Author should perhaps be excused for forgetting, in some instances, that this chosen species is in fact human!

Mr. J. L. SAVOURS

In the opening paragraphs of his paper the Author states that the purpose of a paper is the dissemination of knowledge. This is true, but I cannot agree that it is always intended for all and sundry at all levels of expertise.

At the outset the Author must assume that his paper is being directed to an audience which has a certain level of knowledge of the subject.

A highly technical paper cannot be expected to be so detailed as to be understood by the non-expert, and this is reasonable because it would not be intended for him.

Consequently I would say that having decided his subject, the Author must next decide to whom he wishes to speak, with whom he is trying to communicate. Having found the answers, he will then know the minimum level of expertise at which he should write to suit the experience of his audience.

I can imagine nothing more boring to the expert than 'old hat', and nothing more frustrating to the inexperienced than a speaker persistently talking over his head.

I would also recommend prospective paper writers to start accumulating information and ideas now, if they have not already done so. In writing a paper it may be found necessary to actually record some three or four times as much material as will eventually be used, followed by drastic and ruthless pruning and editing to bring it down to a resonable

length. If extensive notes are pre-recorded the paper can be prepared from a selection of the notes.

Under the heading 'Initial Capitals' I wonder why the Author has complicated an otherwise very readable paper by referring to 'upper case and lower case' when we ordinary mortals refer to these things as 'capital letters' and 'small letters' respectively.

The paragraph on 'Delivery' is particularly interesting because it highlights one of the main problems in obtaining a sufficiency of good, interesting papers for the Technical Association. It is the problem of public speaking.

There are indeed very few technical staff in the Society who have ever had the opportunity to become proficient in this art, and consequently whereas many would probably be prepared to place their invaluable experience on written record, they may very well be inhibited by the frightful thought of having to get up in front of a possibly critical audience and express the same views verbally.

This is a great pity because without doubt every Surveyor who serves the Society either at home or abroad becomes an ambassador for L.R. But what sort of ambassadors do we have without the ability or the wherewithal to get up and readily say their piece, whatever the audience.

The Society would do well to take particular note of this problem and consider ways and means of finding a solution.

Finally, looking back to the paper I read to this august assembly some years ago, I realise now how many mistakes I made, and how much better my presentation may have been, had I had the opportunity to read this one first.

Mr. D. Gray

A number of learned Societies issued what may be broadly described as 'Instructions to Authors'. These documents may not always be available to prospective authors of the Staff Association and this paper by Mr. Cummins would satisfy this need.

One of the earlier speakers referred to the question of preparing and writing papers during normal working hours. I have referred to this subject in the past. However, in my opinion it was not a matter of great moment. There were two distinct phases in the preparation of a paper. The first was what may be called 'the thinking time'; the second was 'the writing time'.

The thinking time involves thinking about the project, the collection and assembly of the material and the final marshalling of the Author's thoughts into a logical sequence. Thus the thinking time could be very protracted; it could extend to a period of many months. Because of the fragmented nature of this portion of the task one could not be specific about doing this in office hours or out of office hours. The thinking is done at all hours of the day, in the office, in the train, at meal times, even in the small hours of the night (if one should wake up at that time).

Once the thinking time had been completed the writing time could commence. In my experience this was a relatively short term task. I write at the rate of one thousand words per hour. However, it is relevant to note that while I could not write at a faster speed, I could not write at a slower speed. In my view every author had his own speed of writing and, once this has been established, it is extremely difficult and, perhaps impracticable, to alter this natural speed. Consequently the writing time for an 8000 word paper was perhaps eight hours. Failure to achieve this in my opinion, was due to inadequate preparation or too short a thinking time. I have spoken to many professional authors and journalists and they had confirmed that this was their own approach to such a task.

Some previous speakers had referred to the recommended length of 5000 words for a paper. In my experience it was much more difficult to write a short paper than a long paper. If an author were permitted 12 000 words the task would be much easier than where the subject matter had to be adequately covered in 5000 words. The latter requires great economy in the use of words. However, I am the first to acknowledge that some limitation must be placed on authors and this opinion is not based on the economics of printing, although this was a relevant factor in the question. My acknowledgement that papers must be limited in length was based on my opinion that long papers, e.g. those in the 12 000–20 000 word category are not read by the audience.

Excessive length in a paper allows the author to introduce irrelevancies which distract the attention of the reader from the main message which the paper contains.

AUTHOR'S REPLY

To Mr. Beckwith

Mr. Beckwith's contribution opening the discussion was much appreciated and, as he has done so many times in the past, he has drawn attention to some of the more important aspects of the subject under consideration—in this case, the writing of technical papers. In doing so he has replied to his own enquiry when he questioned the reason for actually reading the paper.

No matter how good a paper may be, it cannot cover all facets of the subject in such a limited space. Various other points of view, however, can be aired freely in the auditorium making valuable contribution to the paper. In some cases the discussions may be just as important as the paper itself and certainly the open discussion of the subject can throw light into those areas not clearly covered by the paper. This illumination can only occur in the oral discussions, as, regretfully, contributions are never received for papers circulated purely for written discussion.

The possibility of would-be authors being overawed by the apparent magnitude of the task of writing a paper is mentioned. This point was borne very much in mind in the preparation of the guide and many minor side issues were discarded in order to maintain simplicity. Writing papers is not too difficult, but with a little more thought, planning and effort, the author may produce a draft of more acceptable quality. The guide, however, will not guarantee first class works of art. The final results lies purely with the author. Those with something to say should remain undaunted by the task.

Approaches are made, as suggested, to various members who may be able to make useful contributions to the discussions. This is considered, however, to be the function of the

Honorary Secretary and should not be left to the author. Four opening contributions are sufficient to set the ball rolling, and these contributors are generally approached during the week before the meeting, being given, when possible, at least the full weekend prior to the meeting to study the paper in detail in order to prepare their comments.

In pruning the draft for this paper, one of the Sections that was removed was indeed 'Notes for Contributors', thus making the paper purely for the benefit of authors, although many parts are useful to those contributing to discussions. Had these notes been included at this point, they would have been difficult to trace for future reference. They have therefore been added at the end of the Author's replies in a separate appendix. (*See Appendix D.1.*)

With regard to my suggestion that the length of paper be limited to 5000 words, this figure should be used for guidance only and it is readily agreed that certain subjects may not lend themselves to such limitations. Would the '1966 Load Line Convention: Its Implications and Interpretations' have been such a useful document if so contained? However, authors do need guidelines and should in no way be tempted to include superfluous material. A further point authors are well advised to consider is that certain topics make useful papers for bodies external to the Technical Association. If their papers are also to be considered by these learned bodies, then their requirements should be borne in mind. (*See Appendix 1 of the Paper.*)

To Mr. Daniel

The Author is grateful to Mr. Daniel, for in his contribution he raises observations for which the technical members of staff may not have been looking. For instance, attention is drawn to the difference in readership of technical papers compared with the material produced by the Public Relations Department. In each case the recipient is considered and the article produced in a duly acceptable form.

The comments regarding hyphenation are useful and should prove of value to future Secretaries of the Association. Mrs. Russell's study is included for easy reference as Appendix D.2 to these discussions. As can be seen from the Appendix, in setting down guidelines for hyphenation, the Rules become fairly complex. It is, therefore, recommended that authors do not worry overmuch about the use of hyphens and leave this problem to be solved by the editing Secretary.

Concerning footnotes, in the draft the note should be retained as close as reasonably possible to its reference, as the original draft may be amended many times before submission for editing. Major reorganization of a draft may be completed by 'cut and stick', and if the note is on the line following the reference as suggested in the paper, the two should not be inadvertently separated. This arrangement is easily understood and is acceptable to the Printing House staff.

Mr. Daniel makes several good points with regard to the section on oral presentation, which are well worth while being borne in mind by would-be speakers. Mannerisms are mentioned, which can be irritating and distracting to an audience. These should be avoided at all costs. When it was advocated in the paper that audiences wish speakers to be natural, it was not intended to indicate that they should be irritatingly natural. Once aware of such a mannerism, deliberate practice is required to overcome the problem, either by completely avoiding its use or by modification to be less irritating. If still unaware of any unpleasant mannerisms—it is to be hoped that your best friend will tell you.

Similar consideration should be given to the use of a colloquial style of speech. Although pure English is not recommended, a broad distracting accent should be equally avoided. The intent is to make comments to an audience, but the information can only be conveyed if the audience is receptive. Any irritant in speech or manner may cause a breakdown in communication.

The best advice to be given with regard to any oral presentation is—practice, and the best place to practice is in the Association's meetings where a sympathetic audience is available.

Since writing the paper the opportunity has been taken to read 'The Complete Plain Words' by Sir Ernest Gowers, and the Author is indebted to Mr. Daniel for its recommendation. It is indeed a work well worth reading because it concentrates on what matters to the ordinary practitioner, not on what interests only the grammarians and scholars.

To Mr. Jakeman

A number of points raised by Mr. Jakeman have caused the Author to reflect but not to change his opinions.

With regard to the point of case histories (and brevity), it is agreed that they do hold a most important function in painting the picture for the reader and just because they are 'only' case histories they should not be discarded. A case history can be a very vital tool in the presentation of an argument. Two case histories may remove all doubt. Is, therefore, any great purpose served by further additional material in the same vein? It all depends on the interpretation of the word superfluous. The first person to define the term and act accordingly, is the author of the paper himself.

Humour can be found anywhere whether it is expected or not, and generally it would bring delight to the beholder. Deliberate audible humour is recognised by the voice, its tone and inflexion, the timing and the presentation. How many times has a joke appeared to be more humorous on being repeated by a particularly adept comedian. Visual humour is also easily recognised by the manner in which it is presented, the action being easily seen even if it is only a raised eyebrow. There is, therfore, no doubt that both audible and visual humour can be very useful in the auditorium.

Written humour, however, presents a different problem. Jerome K. Jerome can produce a laugh per line with some of his simplest episodes. However, his humour is expected and eagerly sought for, which is not the case with technical papers. If it is not recognised it could be misconstrued, particularly by those not too conversant with the English language.

Many members would appear to hesitate before considering speaking at meetings presumably for fear of making fools of themselves—indicating, of course, that they are self conscious. But the image created is only important to the individual not to the audience and it is the audience that should be considered. The speaker should choose with care exactly what he will discuss and should make his point clearly and concisely. This will do more for the reputation than deliberately trying to make a good impression just by holding the floor.

Mr. Jakeman has spoken (or read) on many occasions and always has something to say and never spends more than a few minutes saying it. He speaks well and holds the attention even though he is reading. He does this by speaking forcefully and clearly, and by raising his head frequently to look

at the audience. However, it is doubtful if he could do this successfully for more than five minutes. Perhaps it is why his contributions are always straight to the point. It would be nice to think there were more 'lesser mortals' like him around and congratulations are due to him for taking the platform on so many occasions.

To Mr. Savours

Mr. Savours' contribution is much appreciated. It had to be read several times before it could be decided if his thinking agreed with the comments in the paper or not. It appears to be in agreement in general, differing only in point of detail and approach.

The point that highly technical papers cannot be expected to be understood by the non-expert is concurred with and this point is acknowledged in Appendix 5 of the paper which asks the referee if the paper is (i) a specialist paper or (ii) of general interest. The author should not assume, however, who will read the paper. He should direct the paper at the specific audience he has in mind.

Even within the Association, which is comprised of the Technical Officers of Lloyd's Register of Shipping, audiences can vary to a tremendous extent. Papers may be directed at

(i) Ship and Engine Surveyors,
(ii) Ship or Engine Surveyors,
(iii) Metallurgists,
(iv) Refrigeration Department Surveyors,
(v) Torsional Vibration Department Surveyors, etc., etc.

Within the Association, the members all being Technical Officers and of reasonable technical ability, the readers should all be capable of understanding the argument of the paper whether or not they are experts in the field under discussion. If the paper is also written for the benefit of a technical institution, the target readership may be narrowed even further, but this is not to say that it cannot be understood by members of the Association who are not of the institution. The author should recognise in the intended reader, not his 'level of knowledge of the subject', but his capability of understanding the present technical argument.

In drawing a comparison between specialist and general papers, the first may deal with new or sophisticated information for the expert. It may be of little interest to the non-specialist but should be understood by him if he chooses to study the subject. The general paper may indeed be 'old hat' to one of great experience but nevertheless could make a valuable reference document for newcomers in the field.

With regard to the accumulation of information in preparing a paper, Mr. Savours comments are completely agreed with and would-be authors would do well to note the points raised, with particular reference to the 'drastic and ruthless pruning'. A good author will collect much more material than he requires for his paper and must resist the temptation to try to use it all.

The comments concerning 'upper and lower case' letters are sympathetically understood. There is indeed no objection to the term 'capital', but 'lower case' is preferred to 'small letters', as its meaning is unquestionable by those concerned with editing or printing the paper. For instance, in requesting the word BULKHEAD to be printed in small letters, would BULKHEAD be acceptable?

The points raised about public speaking are very true and the Society would do well to take note of the comments. It would be difficult to suggest exactly what could be done about it in order to reach all the technical staff. It would be very useful, however, if more Principals would direct individuals to take half an hour to prepare a contribution for 'next Tuesday's' meeting. Having been asked to contribute two or three times, the individual may lose his natural reticence.

To Mr. Gray

The comments made by Mr. Gray have been read by the Author with interest and a little envy. After many months of preparation the actual writing of this paper started at a very low rate perhaps in the order of 100 words per hour, with many hours having no visible end product at all. Nevertheless, as time progressed and the paper developed, the pieces started falling into shape. Less remained to write about, and the speed of putting things down on paper definitely increased. It is doubtful, however, if the rate of 800 words per hour was ever approached, but practice certainly brought improvement.

It can't be said that practice made perfect, for in writing short sections at a time, it was found necessary to repeatedly edit the draft as written, in order to improve the knitting together of the whole paper. It may be true to say that the editing time was about the same as the writing time.

The problem of length of paper has been raised in a previous contribution and Mr. Gray's comments reinforce the Author's opinions regarding the possible temptation to include irrelevancies which may distract the reader.

Mr. Gray is correct in saying that long papers are generally easier to write than short ones. They are also more time consuming to read and are liable to be filed away somewhere out of sight. In order to ensure that communication is made, the paper should be written to suit the reader, who is very much influenced by the volume of material directed at him. The author, therefore, is well advised to keep his paper within useful readable limits without stifling his subject.

APPENDIX D.1

NOTES FOR CONTRIBUTORS TO DISCUSSIONS

Introduction

The object in making a contribution to the discussion of the paper is to convey information appertaining to the subject under consideration, to the members of the Association. This information may be a personal opinion regarding some point made in the paper. It may be additional material not referred to in the paper. It should be complementary to, but need not be in agreement with, points raised by the Author.

The value of the discussion is that it can introduce new associated topics and opinions and gives members the chance to increase their total understanding of the subject. It also affords the Author the opportunity to illuminate further, points which were not quite clear in his paper.

General

Many parts of the Paper are also applicable to the contributions to discussions and may be used as reference in their preparation. What further advice can be given to would-be contributors?

The subject has already been chosen by the Author and a comprehensive document has been prepared. Can anything further be added with advantage?

Obviously the contributor should keep to the point he wishes to make, but sometimes the point becomes a little obscure when all the evidence has been put forward. It is well worth while trying to frame direct questions to the Author to ensure it is understood to which points a reply is required. Even if the contribution consists of pure observation, the author should be requested to make comment on the points raised. These questions could be repeated at the end of the contribution by way of conclusion.

Oral Contributions

Having tried to encourage members to make contributions, it may seem a little unusual now to try to discourage the practice of making contributions repeatedly. The member should carefully pick and choose which papers in the Session are of particular interest to him, and adopt the attitude 'I won't speak at this meeting because I may wish to speak at the next'. As a guideline it is suggested that the member should not speak at more than two or three Association meetings per year.

The reason for proposing this limitation is that no matter how proficient the speaker may be, or how technically sound his comments are, his repeated appearance may cause a little rancour and something is detracted from the reception of his delivery.

Having decided not to speak, the contribution in writing would always be welcomed, and this outlet should always be borne in mind.

If it is decided to make an oral contribution, the next thing to take into consideration is what points are to be made. In order to comment forcefully, the contributor should select only those points most important to him and should resist the temptation to comment on the whole paper. This can be done in the written contributions if so desired.

It is not expected that the contribution need last longer than 12 to 15 minutes—approximately 1000 to 1500 words. Shorter contributions of about four minutes duration (400 words) would equally be appreciated.

It may be possible to use slides, etc., to give added interest and their use is recommended. It is necessary, however, in such cases to approach the Honorary Secretary before the meeting in order that he may make proper arrangements for their showing.

Note should be taken of the comments in the Paper with regard to delivery, with particular reference to the audience. Although the Chairman and author are addressed, the speech should be directed to the body of the hall. The audience should be faced and spoken to. If the speaker turns to face the author to pose a question, the voice is lost to the microphone and the audience, who, not being able to hear what is being said, appears as an eavesdropper to a casual conversation. If the audience is respected, the speaker earns respect.

WRITTEN CONTRIBUTIONS

Bearing in mind the above comments on oral contributions, it is obvious that less limitations need be placed on a written contribution, although it is not expected that it need be longer than 1500 words. Similarly, short contributions of, say, 300 words would be acceptable.

For the oral contributor, it is not necessary to submit exactly, or only, what was said at the meeting. With fresh material being added, and considering the author's verbal replies, it may be that a completely fresh approach is required.

As many contributions are personal experiences, or opinions, it is acceptable for the contribution to be written in the first person.

Illustrations are rarely used in discussions, which is probably why they appear a little forbidding. A figure or two can work wonders in breaking up page after page of solid text. If it is chosen to include a plate or figure, it would be appreciated if it could be submitted to the Honorary Secretary at an early stage so it can be suitably processed.

In order to attempt to circulate the discussions as soon as possible after the paper, it is requested that contributions be submitted within eight weeks of the date of the meeting. The value of the discussion is lost if it is so late in circulation that the original paper has been forgotten.

APPENDIX D.2

The following notes on hyphenation are proffered for guidance only and readers will doubtless be able to cite many anomalies. A good dictionary will usually give a ruling that few will challenge.

1 Adjectives

1 . 1 Hyphenate when compound adjectives consist of:

(a) Noun+participle, e.g. computer-controlled, air-cooled.

(b) Noun+adjective / adjective+noun, e.g. diesel-electric, world-wide, single-screw, four-stroke.

(c) Adjective or adverb+participle, e.g. specially-elected, high-powered.

(d) Noun, adjective or adverb preceded by non-, semi-, electro-, hydro-, petro-, ultra-, uni-, dual-, multi-, self-,
or by a preposition, e.g. on-, off-, under-, over-, out-,
or by the prefix pre- or sub-.

1 . 2 Do *not* hyphenate:

(a) when usage has combined two elements into one word, e.g. ultrasonic, underground, offshore, outgoing, airtight, painstaking.

(b) when an adjective is usually written as two words, e.g. dry cargo (ships), controllable pitch (propeller), higher tensile (steel).

(c) when the adjective forms the predicate of a sentence, e.g. 'The installation is land based.' *but* 'It is a land-based installation.'

2 Nouns

2 . 1 Hyphenate:

(a) when a noun includes a prefix, e.g. mid- (mid-ocean), sub- (sub-committee), re- or de- (if second element begins with 'e'), Vice- (Vice-Chairman, but Viceroy).

(b) when the second element is a preposition, e.g. print-out, shut-off, pick-up.

(c) when each element names part of the complete element, e.g. ferro-cement, nickel-aluminium.

(d) combinations such as Deputy-Chairman, radio-telephone, water-line, air-receiver, gear-box, sea-water.

2.2 Do *not* hyphenate:

(a) for the prefixes re, de, pre, unless the first letter of the second element is 'e'.

(b) when usage has combined two elements into one word, e.g. supertanker, drydock, switchgear, drillrig, steelweight, radiotelegraphy.

3 Verbs

3.1 Hyphenate:

(a) when the verb is preceded by re-, if the verb begins with 'e' or in order to avoid confusion (repair, re-pair).

(b) when a verb beginning with 'o' is preceded by co-.

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THE STRUCTURAL DESIGN OF FIXED AND STEERABLE PROPELLER DUCTS

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THE STRUCTURAL DESIGN OF FIXED AND STEERABLE PROPELLER DUCTS

CONTENTS

1.0 INTRODUCTION

During the last few years the number of propeller duct arrangements fitted to ships of many types has continued to rise, and recent design application has also taken on a wider front with the advent of the very large fixed propeller duct arrangements fitted to VLCC's.

Previously the main exploited advantages of the propeller duct were increased manœuvrability and thrust at low speeds and heavy propeller loadings, and ships such as tugs and trawlers which require these advantages naturally formed the main demand for such arrangements.

This meant that ducts were usually of small to medium diameter and as duct loading is, *inter alia,* a function of size, duct scantlings could not in general be selected to meet allowable stresses, but rather to meet practical considerations such as minimum plate thickness, resistance to local damage or indentation, erosion, etc. On this basis the strength of the smaller duct was rarely in question.

With the wider application of propeller ducts, however, the structural design has become more critical, and as the size of arrangements become larger, it becomes necessary to base the selection of suitable duct scantlings upon the critical design loads as well as upon practical considerations.

The Society has satisfactorily approved the small to medium size duct arrangements and associated sternframes for many years and has recently approved a number of large fixed ducts. Long term field experience of the latter has still to be determined, however, and the aim of this paper is to extend the present methods of approval in order to embrace the larger steerable duct arrangement by presenting a method of calculating critical design loading which would be acceptable for all sizes of arrangements and by presenting suggestions regarding suitable methods of analysis for the duct ring and its associated sternframe elements.

2.0 GENERAL DESCRIPTION

The most common propeller duct arrangements are:—

1. The small to medium diameter steerable duct.
2. The small to medium diameter fixed duct.
3. The large fixed duct.

2.1 The steerable propeller duct

At the present time the types of vessels which commonly use the steerable propeller duct as an alternative to the normal rudder and free propeller are tugs and trawlers.

This arrangement, a typical example of which is shown in Fig. 1, not only gives the required augmented thrust at zero and low speeds but enables greater manœuvrability at these speeds besides giving positive turning ability at all astern speeds, a manœuvre that is often difficult to execute with the normal rudder and free propeller combination.

In order to produce the large side force necessary to give this good manœuvrability a relatively large side area is required and the average steerable propeller duct has a length to diameter ratio of about 0·7, or in terms of duct aspect ratio about 1·4.

The high duct length to diameter ratio, particularly if associated with a relatively crude profile section, as is sometimes the case, can incur appreciable profile drag in the higher speed range and, consequently, as the service speed is reached, duct thrust augmentation is often completely lost and, in some cases, becomes negative.

The performance penalties at service speeds, however, are negligible compared to the substantial advantages that the propeller duct can give in the lower speed range, and as vessels such as tugs and trawlers perform their most important duties in this speed range, the Naval Architect is usually quite happy to accept the lack of advantage at service speed.

The maximum angle of helm for steerable ducts is usually limited to the range 25° to 35°.

To the Author's knowledge, no VLCC steerable duct arrangement exists at the present time, but the advantages of incorporating such an arrangement in this type of vessel could be many whilst the engineering problems would not appear to be much greater than those presented by the normal VLCC rudder, free propeller arrangement.

Some interest in this type of arrangement for VLCC's is being shown, however, and it is likely that serious design consideration and perhaps hardware will materialise in the near future.

2.2 The fixed propeller duct

Whereas the steerable propeller duct is, at the present time, mostly associated with the small vessel, the fixed propeller duct is fitted to both small and large ships, although VLCC application is still in its infancy.

Fig. 2 illustrates a small and a very large fixed propeller duct. Comparing the two, it can be seen that the large fixed duct is more refined from the hydrodynamic viewpoint in that its geometry, both local and general, is optimised more efficiently.

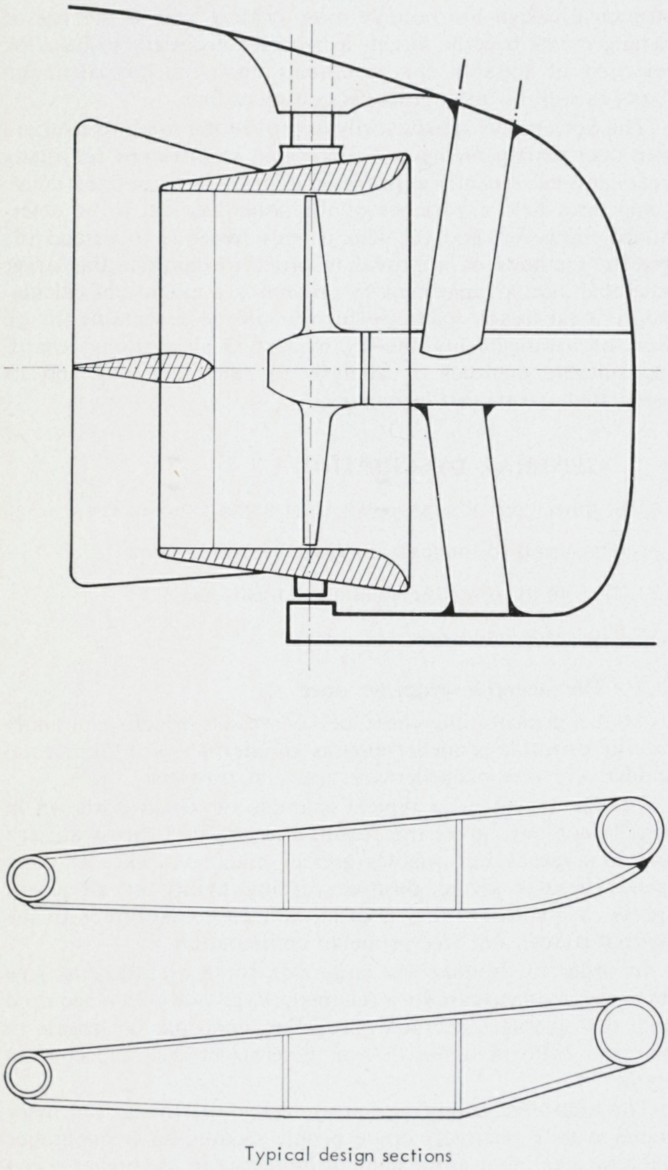


FIG. 1

Typical steerable duct arrangement.

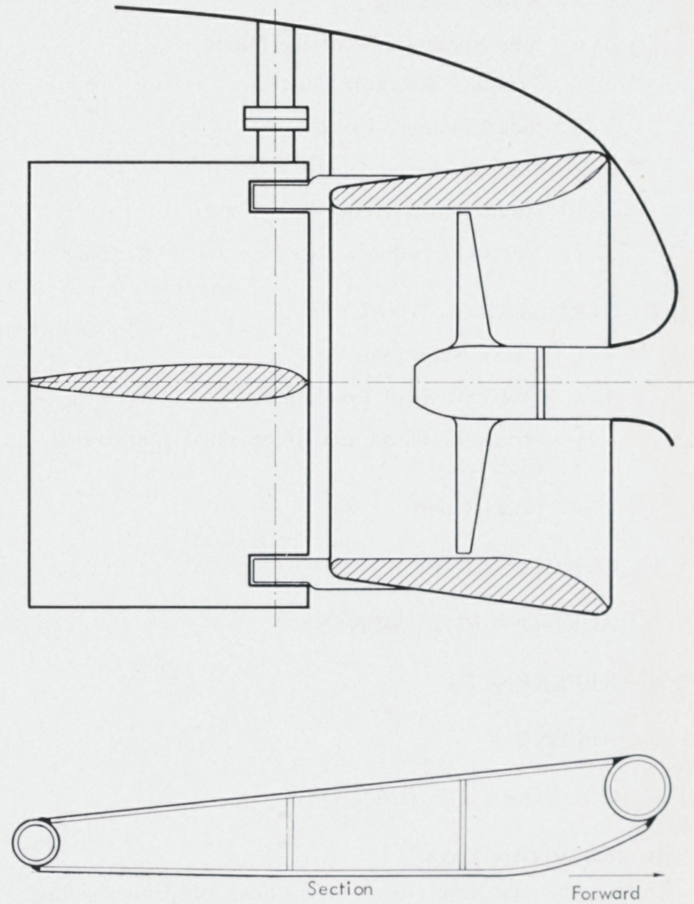


FIG. 2(a)

Small fixed duct.

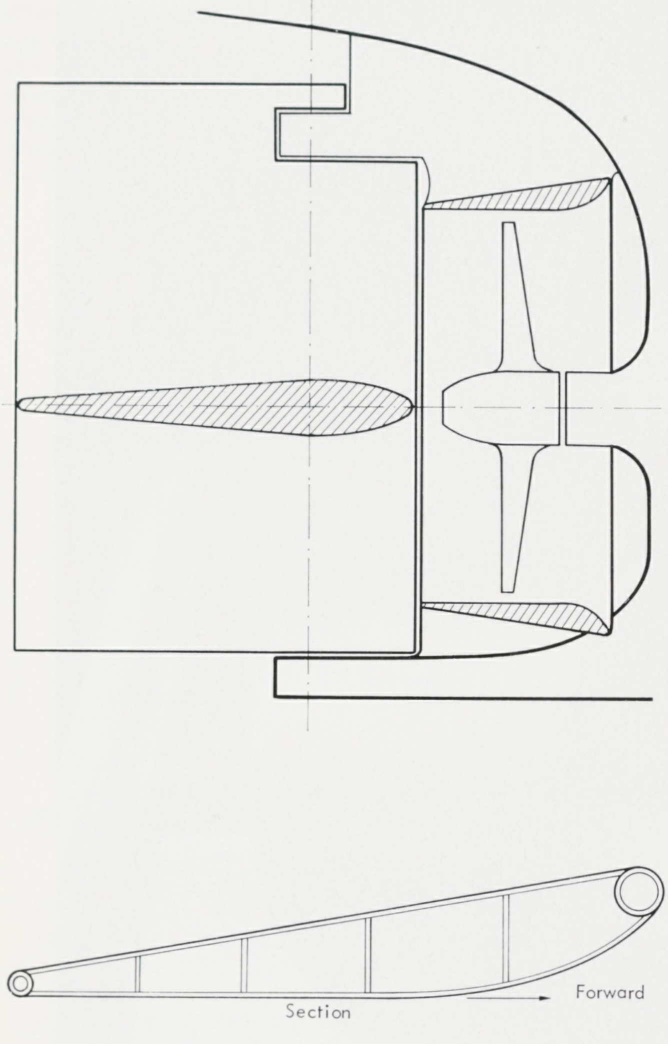


FIG. 2(b)
Large fixed duct.

When a fixed duct is fitted to the smaller vessel, such as a tug, the main requirement is again that of augmented thrust at zero or low speed and the required manœuvrability is often achieved by fitting a large single rudder just aft of the duct or by fitting a complex system of smaller rudders forward and aft of the duct.

The smaller size of fixed duct is often built into the hull structure at the top of the duct only, the area of attachment being kept to a minimum in order to prevent excessive loss of propeller induced circulation. Duct aspect ratios and profiles are usually similar to those of the steerable types and again there is no worthwhile thrust augmentation at service speed.

When fitted to the VLCC, however, the main function of the duct is not to provide thrust augmentation in the lower speed range but rather to improve the propulsive efficiency at service speed. This enables the ship to maintain service speed at reduced engine power or, alternatively, to increase its service speed for the same engine power.

The level of propeller loading at service speed presents serious design problems for this type of duct, but careful control of basic duct geometry and especially of duct profile could lead to a propulsive efficiency gain of approximately 10 per cent.

In order to minimise profile drag, the wetted area of the duct is kept to a minimum, and duct aspect ratios are usually of the order of 2.

The large tanker is particularly suitable for this type of arrangement in that its hull is usually of full form, thus producing a powerful wake, and its engine power is relatively high. These factors, combined with a medium service speed, tend to give a relatively heavily loaded propeller, even through the higher speed range, and the duct is still able to contribute a useful thrust augmentation at these higher speeds.

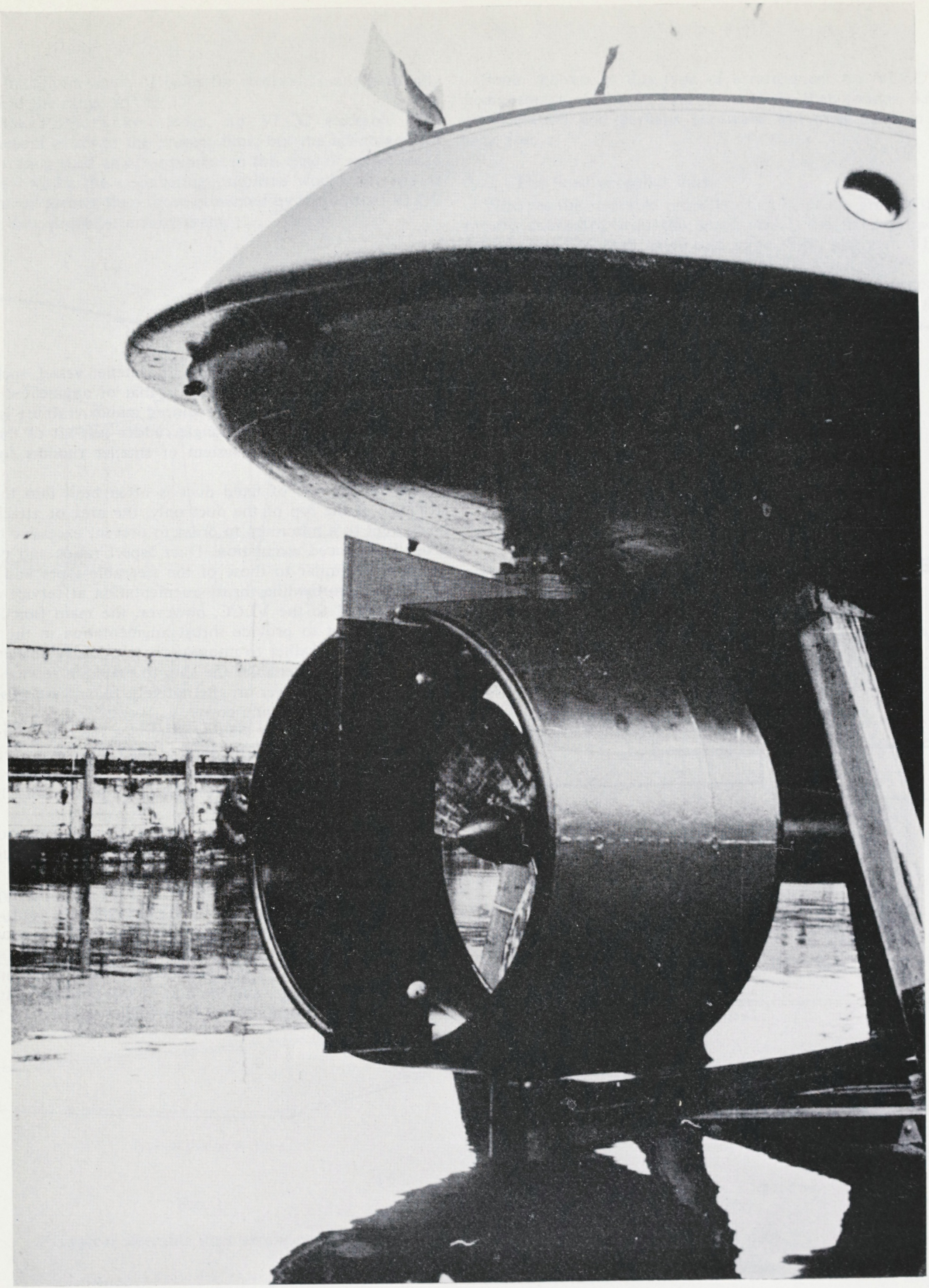


PLATE 1
Typical small Kort duct showing fin arrangement.

Fig. 3 shows a typical plot of K_{TT} against J for a large tanker. From this diagram it can be seen that duct thrust ceases long before propeller thrust and that vessels not requiring thrust augmentation at low speeds and having relatively large J values at service speed have, apart from secondary advantages, little to gain by fitting a duct.

The two most important secondary advantages that the propeller duct can give are improved ship manœuvre response and reduced propeller induced vibration. With respect to the latter, however, much more data is required from existing arrangements regarding service behaviour before any really convincing conclusions can be drawn as to whether the duct can give a really worthwhile reduction in vibration induced structural damage or crew distress. It could be argued, however, that as both of these are of a fatigue nature, even a small reduction in the destructive energy output would be worthwhile.

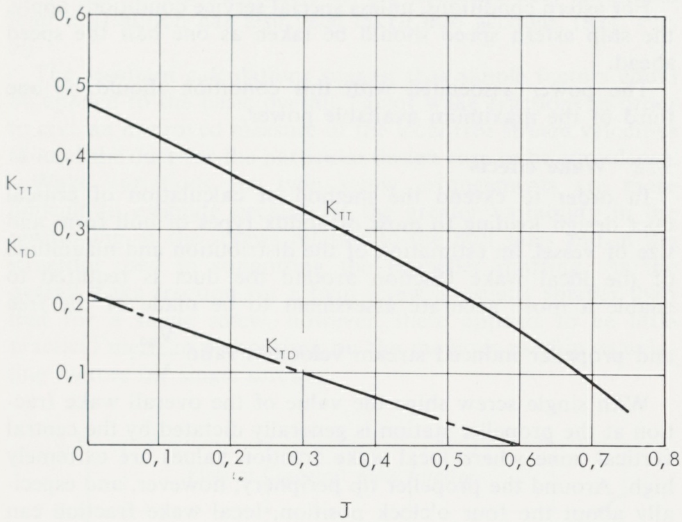


FIG. 3

Plot of K_{TT} and K_{TD} against J for typical tanker form.

3.0 CRITICAL DESIGN LOADS

The critical design loads on a propeller duct arise, with few exceptions, when the duct is at an angle of attack to the propeller induced or free streams.

In the case of steerable nozzles, an angle of attack can arise actively due to the selection of helm. It can also arise passively due to ship motions, conditions which affect both steerable and fixed ducts.

Generally the propeller duct can be likened to a circular hydrofoil blade which is load sensitive to most movements whether vertical or lateral, unlike the normal rudder surface which generates its critical design loads largely in the horizontal plane, very little hydrodynamic loading being created by vertical movement.

As both the propeller induced stream and free stream contribute to the circulation around the duct section, loading cannot be expressed accurately as a function of ship speed only but should include the propeller race strength and wake characteristics.

There are, of course, various ways of incorporating these effects and one common method is that of plotting the duct loading coefficients against the propeller advance ratio. This method, however, is accurate only when restricted to a particular ship or propeller type, as the propeller advance ratio parameter is a measure of geometry rather than of engine power.

In order to obtain the general rather than the particular usage of reasonably accurate loading coefficients, a parameter based upon the relative values of the propeller induced stream velocity and the free stream velocity is suggested.

This can be done on the assumption that the efficiencies of propellers generally vary very little in relation to each other and also on the knowledge that propeller exit speeds are not greatly sensitive to small variations in power or ship's wake speed. The loading coefficients can then be plotted against the non-dimensional parameter $\frac{V_{ad}}{V_e}$ where V_{ad} is the local duct free stream velocity and V_e is the propeller exit speed.

Whilst the Author is aware that this is an unfamiliar parameter, it has the advantage of being relatively simple and of consisting of terms which require evaluation for other parts of the total problem.

The use of the parameter $\frac{V_{ad}}{V_e}$ has enabled a curve of $C_L - \frac{V_{ad}}{V_e}$ to be drawn through test results of a number of ducts operating at different propeller loadings.

On the assumption that C_L max. equivalent is limited to 1·4, induced drag coefficients have been calculated and combined with duct thrust and profile drag coefficients to form C_D equivalents. (Refs. 1 and 2.)

The C_L and C_D coefficients have been resolved normal to and parallel to the duct axis to form C_N and C_{Td} coefficients which would appear to be more useful from the structural analysis aspect.

The duct torque expressions are also based upon a number of test results and allowance has been made for the various duct parameters which influence such torques.

Fig. 4 illustrates duct geometry and basic load sign convention.

3.1 Calculation of exit speed

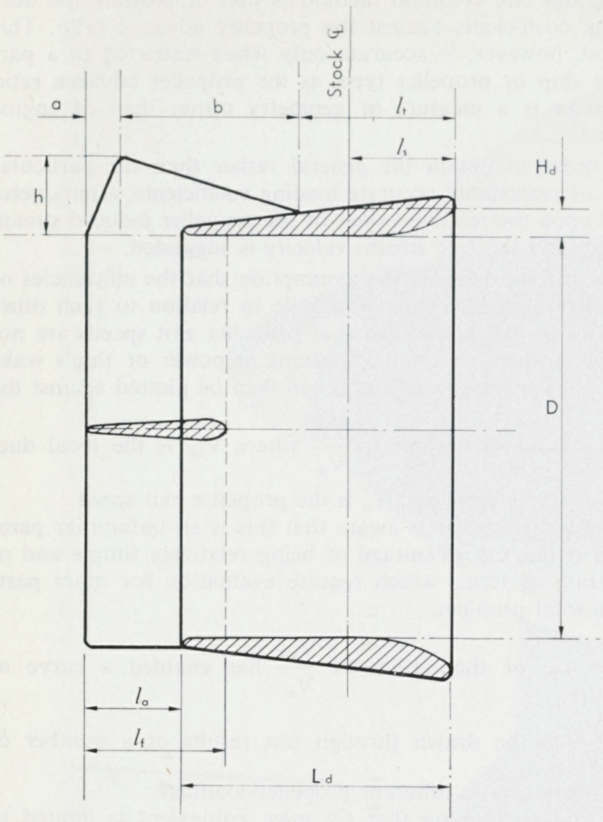
To conform to the general pattern of marine propeller duct design whether of the fixed or steerable kind, the calculation of V_e is based upon the assumption that the diffuser area is relatively small and that the duct is of the accelerating type.

Over the practical range of propeller loading, a general value for efficiency is suggested, this value being reduced in the case of steerable ducts to take into account the increased propeller tip—duct wall clearance which results from the swivelling of the duct relative to the propeller.

Although, of course, the efficiency varies throughout the propeller loading range, the effect of using a general value imposes a relatively small error in the value of V_e.

Then assuming only negligible contraction of the slipstream, V_e is given by

$$V_e^3 - V_e\ V_a^2 = \frac{8\ \eta \times \text{power}}{\rho\ \pi\ D^2} \qquad (1.)$$



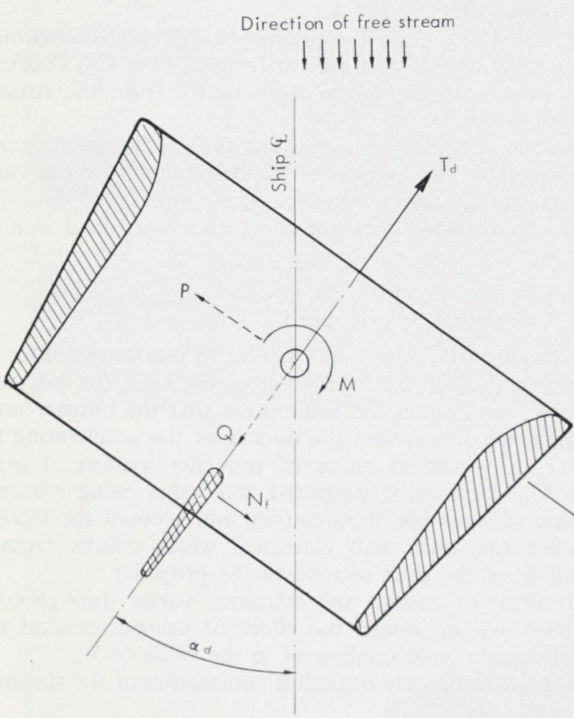


FIG. 4

Duct geometry and load sign conventions.

Suggested values for η are: —

		(Steerable Ducts)	(Fixed Ducts)
Ahead	S.H.P. or D.H.P.	0·6	0·75
	I.H.P.	0·48	0·60
Astern	S.H.P. or D.H.P.	0·35	0·44
	I.H.P.	0·28	0·35

In the case of steerable duct loading which arises from passive angles of attack (i.e. ship's motions) or which is axial when $\alpha_d = 0°$ the fixed duct η's should be used. The power requirements for vessels such as tugs, trawlers, etc., are normally lower in the free running state than when towing or trawling maximum load at lower speeds. However, in view of the fact that allowable stresses for the duct and associated sternframe elements are associated with the maximum available power it is suggested that this value be used in the calculations of V_e.

For astern conditions, unless special service conditions apply, the ship astern speed should be taken as one half the speed ahead.

The power associated with this condition should be one third of the maximum available power.

3.2 Wake effects

In order to extend the method of calculation of critical duct design loading to most orthodox types of hull form and size of vessel, an estimation of the distribution and magnitude of the local wake fraction around the duct is required to enable a more accurate assessment to be made of the free and propeller induced stream velocities ratio $\frac{V_{ad}}{V_e}$.

With single screw ships the value of the overall wake fraction at the propeller station is generally dictated by the central vertical zone where local wake fraction values are extremely high. Around the propeller tip periphery, however, and especially about the four o'clock position, local wake fraction can be very small and in some cases non-existent. Fig. 5 illustrates this large variation in wake for a typical tanker form.

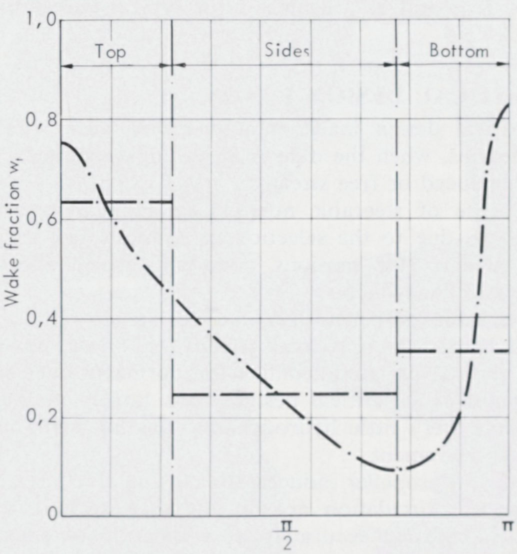


FIG. 5

Typical wake fraction variation for tanker form.

Because of this large peripheral variation in wake, the critical vertical or side forces on a duct would not necessarily be the same even though the ship's speed and respective duct angles of attack were identical for both cases. For instance, a knowledge of the local wake fractions about the top and bottom of the duct would give approximate guidance only to the evaluation of critical side forces but would be necessary to give a more accurate assessment of the vertical loading arising from ship motions.

Then denoting this local stream velocity by V_{ad} in order to distinguish it from the overall free stream velocity V_a values of local Taylor wake fraction based upon the integration of local wake values over quadrants representing the sides and top and bottom of the duct have been estimated. In order to take some account of the homogenising effects of the propeller and duct, typical wake measurements at a distance 0·9 R from the propeller centre line have been used and the 'weighted' effect due to the resolution of the assumed duct sinusoidal load distribution has also been taken into account. (Ref. Fig. 5.)

The resultant calculations suggest that simple factors could be applied to the basic overall Taylor wake fractions in order to give an improved measure of the local free stream velocities around the duct for the particular design case to be considered.

Wake variations for twin screw arrangements are more difficult to estimate because of the greater variability in the positioning of the screws relative to the hull sides and in the structure used in supporting the propeller shafting. As the overall wake fraction for a twin screw is usually smaller than that for a single screw, however, there appears to be little practical merit in elaborating on the methods used in calculating factors for single screws.

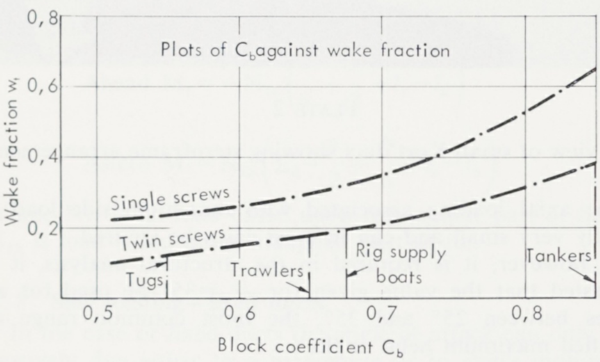


FIG. 6

Plots of C_b against wake fraction.

Fig. 6 shows a plot of Taylor wake fraction against C_b for a B/L of 0·15. An increase of 10 per cent over typical values has been made to allow for the presence of the duct and designated ship types have been positioned along the scale to give assistance in the rapid determination of w_t (Ref. 3).

Then for side load estimation

$$V_{ad} = V\ (1 - 0{\cdot}45\ w) \qquad (2.)$$

(single screw)

$$V_{ad} = V\ (1 - 0{\cdot}2\ w) \qquad (3.)$$

(twin screw)

and for vertical load estimation

$$V_{ad} = V\ (1 - 0{\cdot}75\ w) \qquad (4.)$$

(single screw)

$$V_{ad} = V\ (1 - 0{\cdot}2\ w) \qquad (5.)$$

(twin screw)

Duct thrust or axial loading not coupled with lateral loading (i.e. $\alpha_d = 0°$) should be based on V_a.

3 . 3 Duct loading cases

In practically all sea states duct loading is a mixture of axial, side and vertical loading although, of course, one type of loading will tend to predominate for a given case.

The principal duct loading cases considered are:—

1. Thrust or axial loading together with associated radial loading for condition $\alpha_d = 0°$
2. Side loading together with associated drag loading, radial loading, torque and any incremental side loading caused by external sources such as a rudder in close proximity.
3. Vertical loading together with associated drag loading and radial loading. In order to utilise EQ (9.) which is tailored to the side load case, the associated drag loading should be based upon $V_{ad} = V\ (1 - 0{\cdot}45\ w)$.

3 . 4 Thrust or axial loading, $\alpha_d = 0°$

Thrust loading when the duct is at zero angle of attack could be given by momentum theory, but this does not take into account the degree of profile drag that the average duct creates. (Ref. Fig. 3.)

An estimate of thrust or axial load which takes into account profile drag is given by

$$T_d = 0{\cdot}12\ \rho\ \pi\ D^2\ (V_e - 1{\cdot}45\ V_a)^2 \qquad (6.)$$

When the duct is inclined to the free stream the axial load cannot be given by modified momentum theory as it is considerably modified by the reduced efficiency, lift component, induced drag, etc.

In these cases axial loading has been dealt with under the relevant lateral loading cases as an associated condition.

3 . 5 Radial loading

Radial loading, in itself, is not usually critical in that it affects the associated sternframe structure in only a minor way and creates relatively small stresses in the duct ring structure.

However, if required for purposes of completing the load system, an estimate for a typical duct is given by

$$F_d = \rho\ \pi\ DL_d\ V_e^2 \left(0{\cdot}47 - 0{\cdot}72\ \frac{V_a}{V_e}\right) \qquad (7.)$$

3 . 6 Side loading—steerable ducts

The magnitude of side loading, unlike axial loading when $\alpha_d = 0°$ or vertical loading due to ship's motions depends, *inter alia*, on whether the duct is of the steerable or fixed type, the angles of attack and hence loading arising in quite different ways.

In the assessment of side loading the steerable duct usually presents the simpler problem in that the maximum angle of helm and maximum service speed are nearly always specified. On assuming that such angle of helm is obtained before any significant ship's drift has developed, the basic problem is reduced to that of a propeller duct inclined to the free stream

with its effective angle of attack equal to the specified maximum angle of helm and the free stream velocity equal to the specified maximum service speed corrected for wake effects.

In order to simplify the problem of assessing loading for all angles of helm it has been assumed that maximum side load is reached at $\alpha_d = 35°$ and that the curve of $C_N - \alpha_d$ up to this value is of sinusoidal form. (Ref. 4, 5, 6 and 11.)

In practice the $C_N - \alpha_d$ curve usually reaches a maximum value between the range $\alpha_d = 35°$ to $55°$, the variation being caused primarily by propeller loading and duct aspect ratio.

However, the curve is reasonably flat over this region and any error introduced by the assumption that C_N maximum occcurs at $\alpha_d = 35°$ would be reasonably small even for a particular duct case which caused C_N maximum to occur at $55°$.

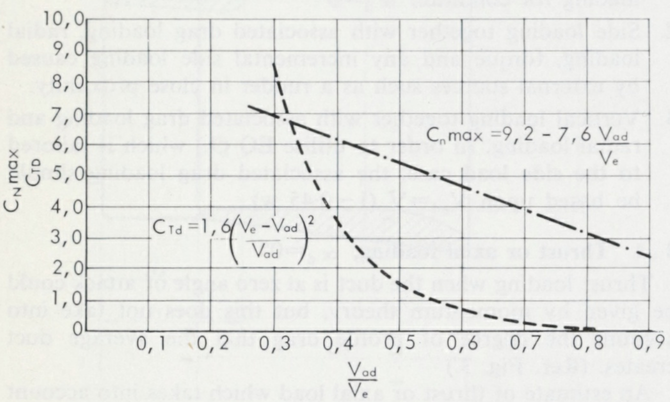


FIG. 7

Plot of $C_N$max and C_{Td} against V_{ad}/V_e for helm angle 35°.

Fig. 7 shows a plot of the side and associated axial loading coefficients C_N maximum and C_{Td} against $\frac{V_{ad}}{V_e}$

In equation form and over the practical range $\frac{V_{ad}}{V_e} = 0{\cdot}3$ to $0{\cdot}9$, side and axial loadings are given by

$$N_d \text{ max.} = \left(4{\cdot}6 - 3{\cdot}8 \frac{V_{ad}}{V_e}\right) \rho \, DL_d \, V_{ad}^2 \quad (8.)$$

$$T_d = 0{\cdot}8 \left(\frac{V_e - V_{ad}}{V_{ad}}\right)^2 \rho \, DL_d \, V_{ad}^2 \quad (9.)$$

When calculating loading for helm angles less than 35° it is recommended that some allowance be made for ship's motions.

Estimations based upon the relevant probability of such motions during helm manœuvres suggest an incremental angle of $\pm 3°$.

Then for 30° helm angle the factor to apply to C_N maximum would be

$$\text{Sin}\left(\frac{30+3}{35} \times 90\right)° = 0{\cdot}996, \text{ say } 1{\cdot}0 \quad (10.)$$

and for 25° helm angle the factor would be

$$\text{Sin}\left(\frac{25+3}{35} \times 90\right)° = 0{\cdot}95 \quad (11.)$$

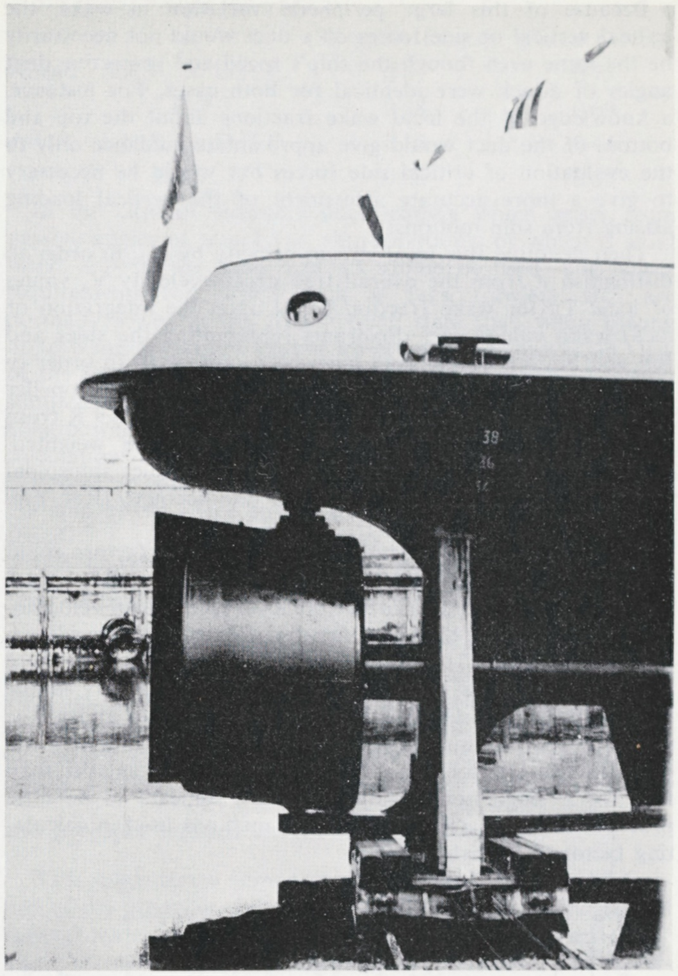


PLATE 2

Side view of small Kort duct showing sternframe arrangement.

The axial loading associated with maximum side load is usually very small and can in most cases be ignored.

If, however, it is required in the structural analysis, it is suggested that the value given for $\alpha_d = 35°$ be used for all angles between 25° and 35°, the most common range of specified maximum helm angle.

Most steerable ducts incorporate a fin in their arrangement in order to increase the side load and hence ship response. As the leading edge of the fin is usually well inside the duct or level with the trailing edge of the duct, considerable circulation interference takes place and the side load generated by the fin is considerably smaller than that which would result from a similar but isolated lifting surface.

A side load estimate for the fin taking into account circulation intereference and allowing for duct aspect ratio (*see* Refs. 6 and 7) is given by

$$\text{Ahead } N_f = \rho \, A_f \, V_e^2 \left(0{\cdot}04 \frac{D}{L_d} + 0{\cdot}3\right) \text{Sin } \alpha_d \quad (12.)$$

In the case of astern movement the fin loading is further complicated by the duct inflow velocity which, *inter alia*, varies across the duct and according to the distance aft from the duct trailing edge. Taking into account these additional

parameters an estimate for side load when moving astern is given by

$$\text{Astern } N_f = \rho\, A_f \left[V_e \left\{ 1{\cdot}32 \frac{l_a}{D} \left(\frac{V_a}{V_e} - 1 \right) + 1 \right\} \right]^2 \left(0{\cdot}045 \frac{D}{L_d} + 0{\cdot}47 \right) \left(\frac{l_a}{D} + 1 \right) \operatorname{Sin} \propto_d \qquad (13.)$$

3 . 7 **Torque—steerable ducts**

Torque due to side load depends, *inter alia,* upon propeller loadings, aspect ratio, chordwise position of propeller within duct and angle of attack.

Expressing the torque about the stock centre line

$$\text{Ahead } M_{ds} = N_d \left\{ \left(0{\cdot}25 - 0{\cdot}31 \frac{V_{ad}}{V_e} \right) \left(0{\cdot}5D - 0{\cdot}7L_d \right) - \left(0{\cdot}21L_d + 0{\cdot}11ls \right) \left(0{\cdot}84 - 0{\cdot}32 \frac{V_{ad}}{V_e} \right) \left(1 + 0{\cdot}015 \propto_d \right) + ls \right\} \qquad (14.)$$

$$\text{Astern } M_{ds} = N_d \left\{ \left(0{\cdot}25 - 0{\cdot}31 \frac{V_{ad}}{V_e} \right) \left(0{\cdot}5D - 0{\cdot}7L_d \right) - \left(0{\cdot}32L_d - 0{\cdot}11ls \right) \left(0{\cdot}84 - 0{\cdot}32 \frac{V_{ad}}{V_e} \right) \left(1 + 0{\cdot}015 \propto_d \right) + L_d - ls \right\} \qquad (15.)$$

The estimate for torque contribution due to the fin is

Rectangular portion

$$\text{Ahead } M_f = -N_{f1} \left(L_d + l_a - 0{\cdot}75\, l_f - l_s \right) \qquad (16.)$$

$$\text{Astern } M_f = N_{f1} \left(L_d + l_a - 0{\cdot}33\, l_f - l_s \right) \qquad (17.)$$

Triangular portion

$$\text{Ahead } M_f = -N_{f2} \left(\frac{a}{6} + \frac{b}{2} + l_t - l_s \right) \qquad (18.)$$

$$\text{Astern } M_f = N_{f2} \left(L_d - \frac{a}{2} - \frac{b}{6} + l_a - l_s \right) \qquad (19.)$$

Where N_{f1} is fin load based upon rectangular part of fin and N_{f2} is load based upon triangular part of fin.

3 . 8 **Side loading—fixed ducts**

In the case of fixed ducts the angle of attack can only arise passively due either to a manœuvre or to ship's motions. It will, of course, pick up side load due to a helmed rudder in close proximity even before the ship has developed drift, but this is dealt with as a separate loading case.

The effectiveness of drift angle due to turn or to ship's motions is influenced by the after body shape and position relative to the duct and also to the hull straightening effects. These factors further complicate the already difficult problem of assessing the maximum angle of attack likely to occur. However, by adopting certain general values for ship response and manœuvre characteristics, coupled with a pattern of typical ship speed reduction and probable ship's motions during such manœuvres, an estimate can be made of the maximum duct angle of attack likely to arise.

Based upon the following assumptions, investigations suggest that the maximum duct load is likely to occur during the early stages of a turn. (*See* Refs. 7, 8 and 9.)

These assumptions are:—

1. Steady turning circle 2·5 LBP in diameter
2. Ship pivot point 0·33 LBP from FP
3. Rudder drift angle βr decays exponentially
4. $V = 0{\cdot}5\ V_s$ when β_r reaches terminal value or is sensibly constant
5. Hull straightening effects reduce $\propto_d$ due to drift to 0·75 β_r this reduction not including propeller straightening effects which are a function of propeller loading and which are dealt with separately.

Fig. 8 illustrates qualitatively the variation in drift angle, ship's speed and duct load against time.

The investigations suggested a β_r value of 28° which was independent of ship size or form. This value compares favourably with that calculated by Okada who obtained 25°, again independent of ship geometry.

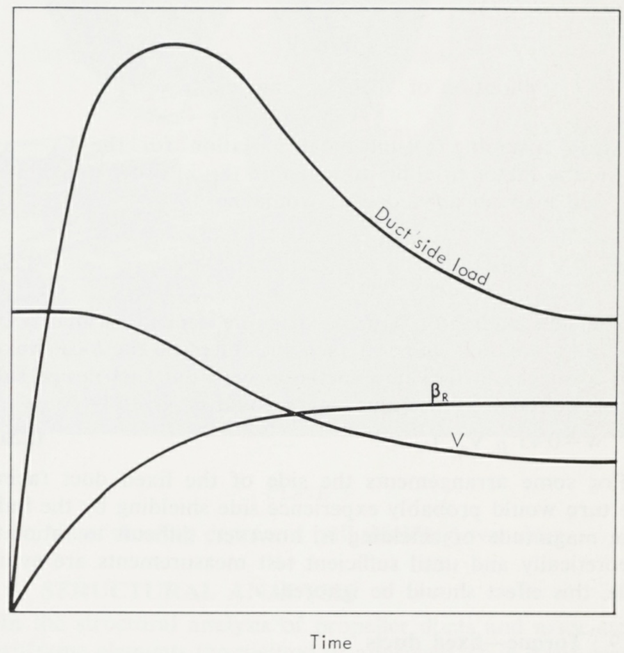


FIG. 8

Qualitative variation in drift angle, ship's speed and side load against time for a typical fixed duct.

Then adding to β_r the effects of ship's motions and allowing for hull straightening effects the maximum angle of attack likely to be encountered in practice is given by

$$\propto_d = (-0{\cdot}57\ C_b + 1{\cdot}37)\ (-0{\cdot}0125\ \text{LBP} + 31)^\circ \qquad (20.)$$

The effective associated free stream velocity at the duct will be modified by the drift, etc., and is given by

$$V = 0{\cdot}9\ V_s \operatorname{Sec} \propto_d \qquad (21.)$$

The appropriate wake correction factor is then applied to V.

In the case of a fixed duct the angle at which C_N maximum occurs has a much greater variation than that given by a steerable duct. This is principally due to the fact that the propeller does not swivel relative to the duct. Owing to this variation the steerable duct assumption that C_N maximum

occurs at $\propto_d = 35°$ is not valid for fixed ducts and Fig. 9 gives a plot of $\propto_{dCN}$ maximum against $\frac{V_{ad}}{V_e}$. (*See* Ref. 10.)

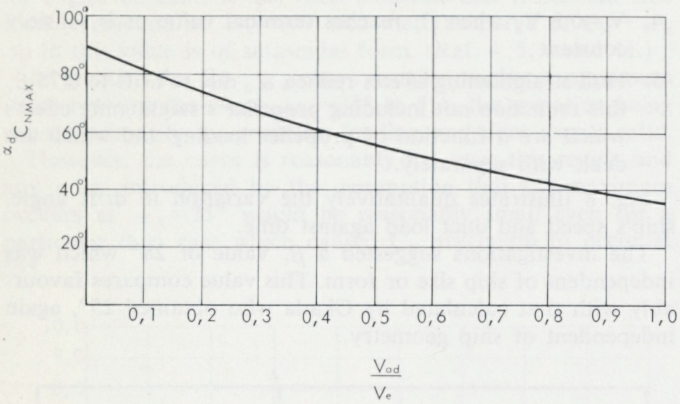


FIG. 9

Variation of $\propto_d C_{NMAX}$ against V_{ad}/V_e.

Again assuming a sinusoidal variation for the $C_N - \propto_d$ curve, the factor to apply to equation (8.) in order to evaluate the side load on a fixed duct would be

$$\operatorname{Sin}\left(\frac{\propto_d \times 90}{\propto_{dCN}\ \mathrm{max}}\right)^{\circ} \qquad (22.)$$

The side loading on support structure depends primarily on the cross sectional shape of such structure and the local wake.

It is suggested that in association with the duct design side force, side loading per unit length could be given by:—

$$w = 0\cdot45\ \rho\ V_a^2\ L_s \qquad (22a.)$$

For some arrangements the side of the fixed duct facing the turn would probably experience side shielding by the hull. The magnitude of shielding is, however, difficult to estimate theoretically and until sufficient test measurements are available, this effect should be ignored.

3.9 Torque—fixed ducts

The torque due to side load on a fixed duct is different from that arising on a steerable duct again due to the fact that the propeller does not swivel relative to the duct.

The estimate of torque about the leading edge is given by

$$\text{Ahead } M_{d1} = N_d \left\{ \left(0\cdot25 - 0\cdot31 \frac{V_{ad}}{V_e}\right) R - \left(0\cdot21\ L_d + 0\cdot11\ l_s\right) \right\} \qquad (23.)$$

3.10 Rudder interference side load

Very little data exists regarding propeller duct side loads arising from external sources such as a closely situated rudder.

Gunsteren and Gunsteren have investigated the influence of a fixed duct on a rudder with respect to ship response and Sontveldt and others comment on rudder, duct interference loads with suggestions regarding magnitude of loading. (*See* Refs. 9, 11 and 12.)

The main factors in this problem would appear to be the relative circulation strengths, surface areas and distance between the two lifting surfaces.

Using these parameters and incorporating the data suggested by the above investigators, an estimate of the duct side load due to rudder interference is given by

$$N_{dr} = N_r \left(0\cdot93 - 1\cdot5 \frac{c}{D}\right) \left(0\cdot1\ \frac{A_d}{A_r} + 0\cdot07\right) \qquad (24.)$$

It is suggested that this side load be applied to the side of the duct nearest to the leading edge of the rudder when the rudder is in the helmed condition and that the CP be situated 0·75L from the duct leading edge, i.e.

$$M_{dr} = 0\cdot75 N_{dr}\ L_d \qquad (25.)$$

In the normal continuous turn manœuvre the rudder interference side load would be in opposition to the basic duct side load caused by drift thus causing a reduction in overall side load, but the location of the CP's of the respective loads would normally cause an increase in torque about the support struts.

With rapid application of opposite helm, however, as in a zig-zag manœuvre, the two side loads would be additive although the torque would be reduced.

N_r can be estimated from the Rules. Ref. rudder pintles. For this calculation use V_s.

3.11 Vertical loading—steerable and fixed ducts

Duct vertical loading can be caused by a variety of reasons but the critical loading conditions usually arises from the vertical movement of the duct due to pitch and heave whilst the ship is travelling at or near its service speed.

Generally the magnitude of pitch and heave together with the associated wave conditions increase in accordance with the severity of the weather and in the estimation of maximum vertical loading this trend has been coupled to the assumption that the ship, according to its size, maintains full service speed up to Beaufort Nos. 4 to 6, thereafter progressively reducing speed to 0·25 V_s at Beaufort No. 12.

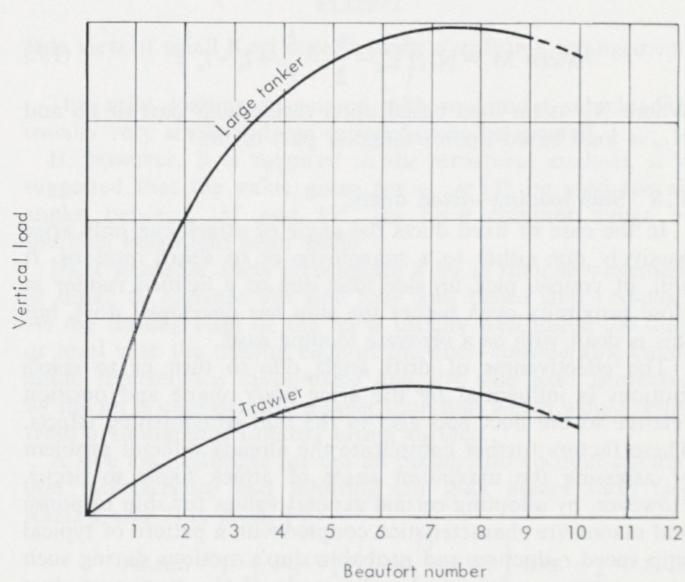


FIG. 10

Qualitative variation of duct vertical load due to ship's motions against Beaufort Number.

At high Beaufort numbers the reduced ship's speed effectively reduces the duct loading despite the larger angle of attack and Fig. 10 qualitatively illustrates this tendency by showing a plot of estimated duct vertical load against Beaufort number for a large and a small ship. (*See* Refs. 3 and 13.)

With the normal single screw arrangement considerable shielding is afforded by the hull which in a hydrodynamic sense acts as a powerful source or sink. Simple flow theory shows that the nominal vertical angle of attack for a typical duct arrangement can be substantially reduced by the presence of the hull and in the estimation of critical angles of attack a reduction factor of 0·44 has been used on the vertical velocity flow component to take into account the hull presence.

In the case of twin screw ducts, however, the effect of hull shielding can be very much reduced and it is suggested that no alleviation factor be used for this type of arrangement.

In addition to the duct angle of attack caused by ship's motions there is often a residual angle of attack caused by the hull trailing vortex system.

This system, of course, varies greatly from ship to ship and a reliable estimation can only be made through extensive tank testing. Prudence would suggest, however, that some allowance be made for this condition and an incremental angle of 5° is suggested for the shielded duct.

The estimated vertical maximum duct angles of attack are given by: —

Shielded ducts LBP range 50 to 90 m

$$\alpha_d = \{(-0{\cdot}15\ C_b + 1{\cdot}1)\ (0{\cdot}04\ \text{LBP} + 33) + 5\}^\circ \qquad (26.)$$

Shielded ducts LBP range 90 to 400 m

$$\alpha_d = \{(-0{\cdot}15\ C_b + 1{\cdot}1)\ (0{\cdot}05\ \text{LBP} + 41) + 5\}^\circ \qquad (27.)$$

Exposed ducts LBP range 50 to 90 m

$$\alpha_d = (-0{\cdot}9\ C_b + 1{\cdot}59)\ (0{\cdot}11\ \text{LBP} + 39)^\circ \qquad (28.)$$

Exposed ducts LBP range 90 to 400 m

$$\alpha_d = (-0{\cdot}9\ C_b + 1{\cdot}59)\ (-0{\cdot}064\ \text{LBP} + 55)^\circ \qquad (29.)$$

The effective free stream velocity at the aft end will be modified by the vertical movement and is given by

$$V = V_s \text{ Sec } \alpha_d$$

The appropriate wake correction is then applied to V.

The shielded duct α_d's given by EQ's 26 and 27 are applicable to the duct upload case, i.e. stern moving down. Limited test data suggests that when the stern is moving up, considerable shielding is given and the duct down load is relatively small.

Consideration was given to vertical loading arising from duct surfacing. The calculated level of loading was in the same order as that given by normal up and down movement of the duct but as considerable air drawing would take place under surfacing conditions, reliance could not be placed upon a theoretical approach and this line of investigation was not pursued.

When considering an open stern arrangement (i.e. no solepiece), factor vertical loads derived from EQ (26.) and (27.) by 1·1.

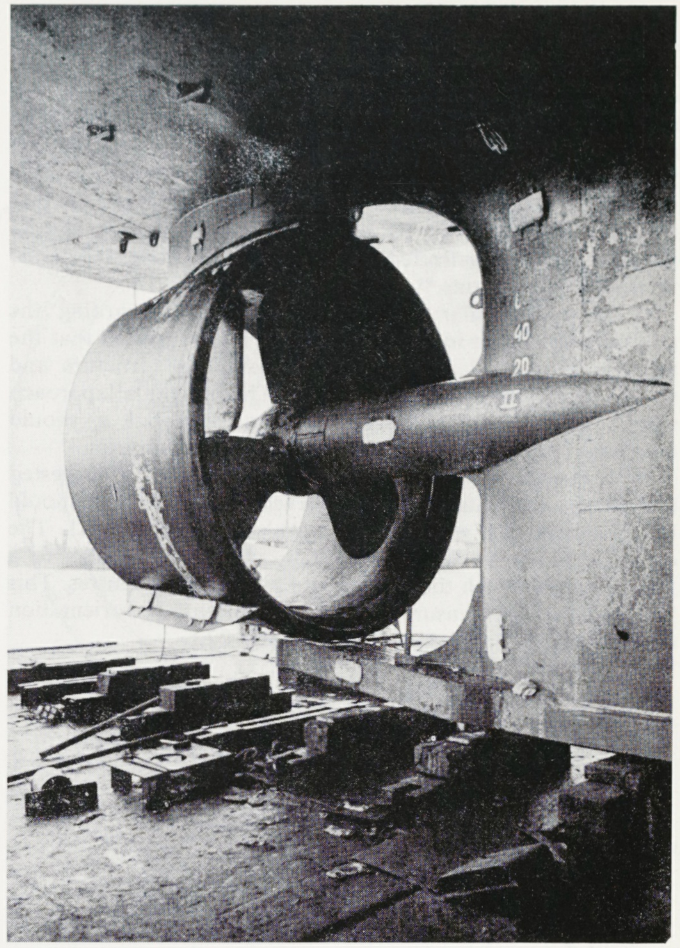


PLATE 3

View showing degree of hull shielding over duct.

4.0 STRUCTURAL ANALYSIS

In the structural analysis of propeller ducts and associated sternframe elements the method of approach, as in some cases of applied loading, depends to a great extent on whether the arrangement is of the steerable or fixed type.

In the case of the steerable duct the tendency is for the sternframe arrangements to be relatively more complex than that serving a normal rudder, free propeller combination. This complexity makes it difficult to simplify the sternframe internal load distribution calculation in a manner similar to that laid down in the Rules for normal rudders, and in keeping with the philosophy laid down in the LR.3 structural analysis program the approach suggested by the Author embraces all pertinent sternframe members. However, in order to avoid excessive complications or number of terms in the internal load equations, the structural properties of each member have been confined to that member's primary role; i.e. a member primarily in bending has been treated as such, no allowance having been made for secondary forms of displacement such as flexural or torsional shear deformation. This approach still enables an accurate assessment to be made of the internal load distribution without destroying the practical aspects of such a method.

Fixed ducts, especially the very large ones, present a different problem in that they are often fully built into the sternframe at or near positions of greatly varying or highly curved structure. This makes it difficult to employ standard methods of idealisation which would give the degree of accuracy normally required. Fortunately the critical internal forces in the duct ring itself are not greatly affected by the method of attachment of the duct to the sternframe in that they are usually given by the vertical loading case and as such are largely unaffected by the structural properties of the vertical support struts.

If, in a particular example, doubt exists regarding the applicability of the idealised approach, it is suggested that the analysis be carried out by particularising the structure and using the normal computer facilities. The individual approach would, of course, be more time-consuming but it should eliminate large errors caused by unrealistic idealisation.

With respect to the duct stiffness properties, it is suggested that in the calculation of I_{DXX} curved plate efficiency should be considered for single curvature plating. Ref. Fig 11. The datum axis chosen to calculate I_{DXX} should be parallel to a line passing through the leading and trailing edge centres. This will, in most cases, ensure good agreement with the orientation of the principal axis. (*See* Refs. 14 and 22.)

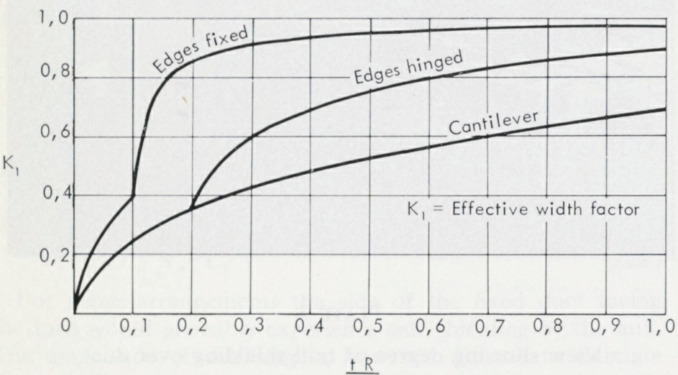


FIG. 11

Curved plate efficiency.

For a typical duct section the torsion constant J_D can be given with reasonable accuracy by:

$$J_D = \frac{4{\cdot}4\ A_S^2}{\oint \frac{ds}{t}}$$

When analysing sternframe arrangements which incorporate small ducts that do not require stressing, it is suggested that the duct stiffness properties be calculated from a generalised method. This could take the form:

$$I_{DXX} = K_2\ L_d\ H_d^2\ t$$

$$I_{DYY} = K_3\ L_d^2\ H_d\ t$$

$$J_D = K_4\ L_d\ H_d^2\ t$$

K_2, K_3, K_4, could be evaluated from a sample of typical duct sections.

4.1 Stress allowables

Recommended stress allowables for the duct structure and associated sternframe elements are given below.

Stress allowables on structural items not previously covered by long term field experience, i.e. very large ducts and their support structure, have been derived from damage calculations based upon long term predictions and fatigue data given by B.S.153 and A.W.S. D1–1–72. (*See* 15, 16, 17, 19 and 20.)

	kg/cm²	t/in²
Small to medium ducts ... ... (fitted to tugs, trawlers, etc.)	630	4·0
Large ducts ... ... (fitted to carriers, etc.)	550	3·5
Stocks		
Upper section	630	4·0
Lower section	945	6·0
Solepiece ... ... (steerable arrangement)	710	4·5
Solepiece support struts ... ... (steerable arrangement)	710	4·5
Fixed duct support struts ... ... (small ducts)	630	4·0
Fixed duct support struts ... ... (large ducts)	550	3·5

Solepieces in arrangements incorporating a fixed duct and normal rudder should be examined on the basis of the required Rule section modulus being factored by the ratio of the total solepiece BM given by the duct load and Rule rudder load to the solepiece BM given by the Rule rudder load alone.

For panels in compression or shear, reference should be made to Staff Association paper No. D2 and other relevant sources. (*See* Ref. 18.)

Duct fittings and sternframe elements common to both duct and normal rudder arrangements, i.e. pintles, coupling bolts, etc., should be referred to the Rule requirements for rudders.

With regard to ice class the Rule requirements for normal rudder arrangements should be used.

In the case of small ducts not specifically designed on the basis of allowable stresses, Fig. 12 gives recommended minimum plate thicknesses. These thicknesses are, of course, based more upon practical considerations.

4.2 Distribution of loading around duct

In order to analyse the duct and its associated sternframe structure under the various load cases, an estimation of load distribution around the duct is required.

From the structural aspect it has been found that the internal forces in the associated sternframe elements are not very sensitive to the type of load distribution around the duct or to whether the loading is predominantly on one side of the duct. Likewise with the duct ring structure the internal forces are not greatly sensitive to small changes in load distribution when considering the critical design conditions which for the duct are usually given by vertical loading cases.

For ring aerofoils the basic distribution for lateral loading can be represented reasonably accurately by a sinusoidal variation and this form has been adopted for both side and vertical loading cases.

Fig. 13 illustrates the assumed loading distributions for the various cases.

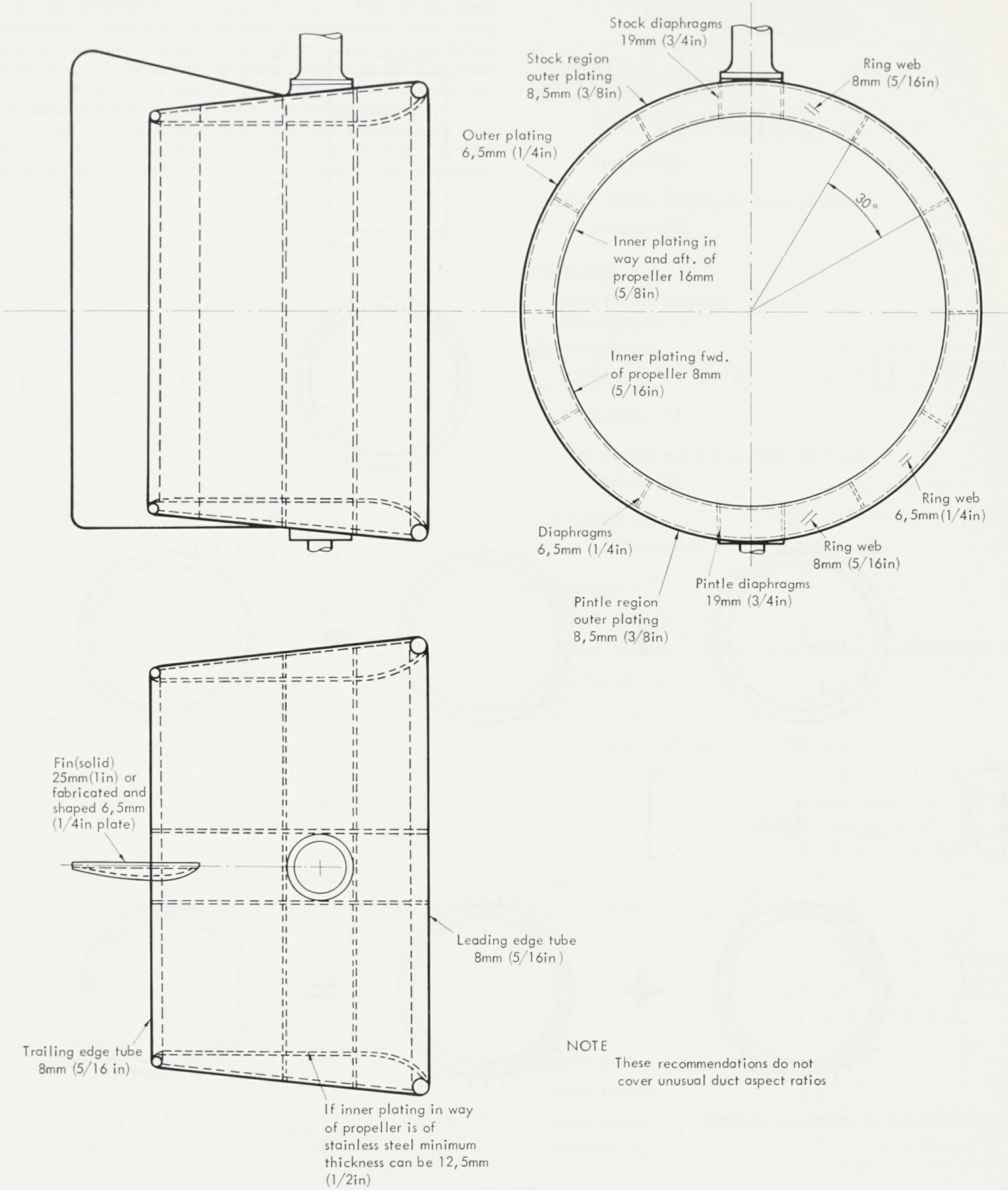


FIG. 12

Recommended minimum scantlings for small ducts of typical aspect ratio (i.e. 1·5) and up to 3 m (10 ft) in diameter.

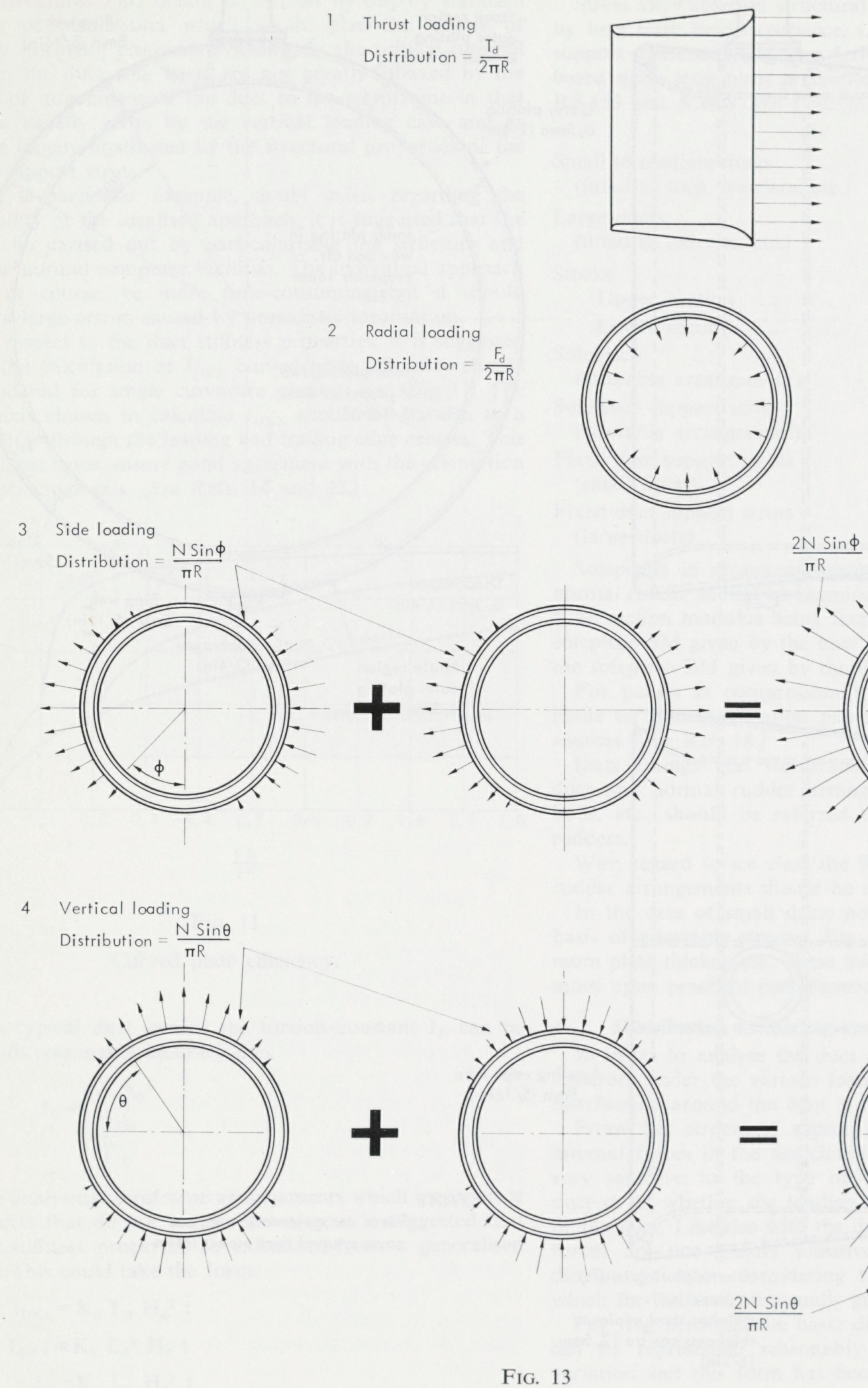


FIG. 13

Assumed basic duct load distributions.

4.3 **Steerable ducts and associated sternframe elements**

In the consideration of steerable ducts, five of the most commonly occurring sternframe arrangements have been analysed and the solution to the distribution of internal forces in the duct and sternframe elements given. The direct product of these equations is that of the pintle vector, and from this the other relevant internal forces can be determined.

The five types of arrangement considered together with their idealised structural equivalents are shown in Fig. 14. The equations giving the pintle vectors are given in the Appendix.

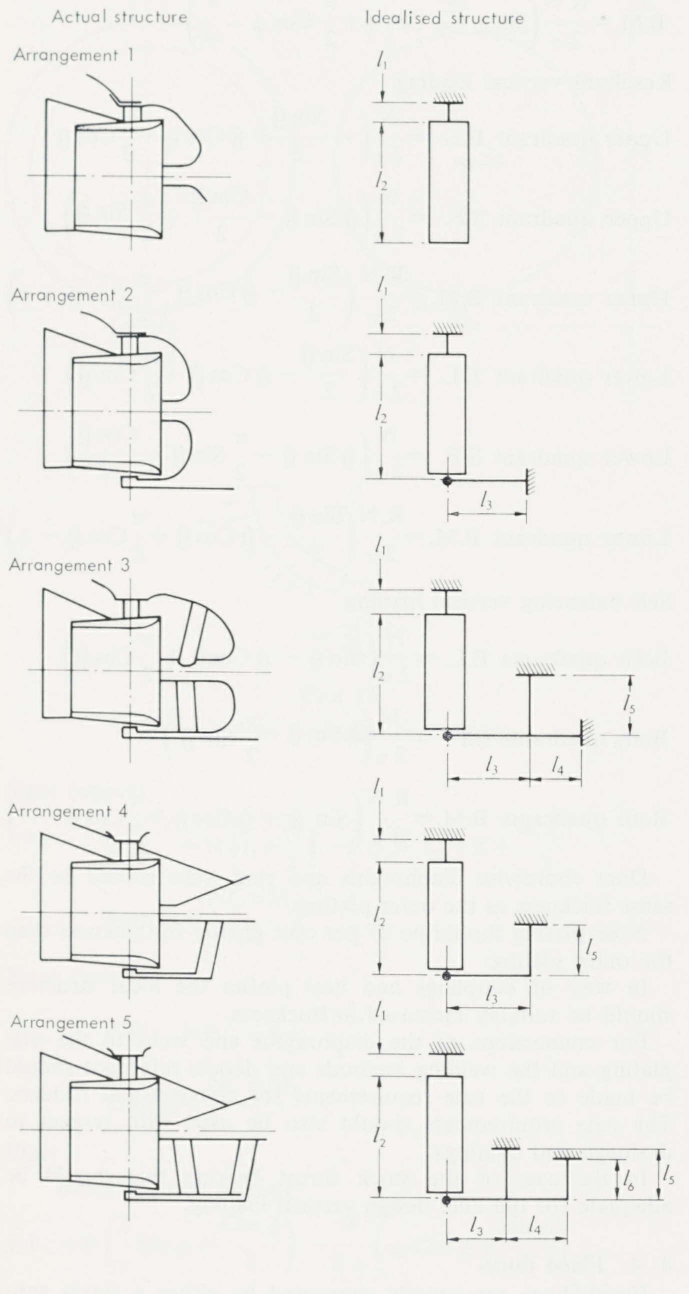


Fig. 14

Arrangement 1

$$\left.\begin{array}{l} P=O \\ Q=O \end{array}\right\} \text{No pintle support}$$

Stock (lower bearing)

$$\text{B.M.} = \sqrt{N^2+T_d{}^2\left(l_1+\frac{l_2}{2}\right)}$$

Torque = M

Stock (upper bearing or tiller position)

Torque = M

Arrangement 2

Stock (lower bearing)

B.M. =

$$\sqrt{\left\{N\left(l_1+\frac{l_2}{2}\right)-P\ (l_1+l_2)\right\}^2+\left\{T_d\left(l_1+\frac{l_2}{2}\right)-Q\ (l_1+l_2)\right\}^2}$$

Torque = M

Stock (upper bearing or tiller position)

Torque = M

Solepiece (l_3)

$$\text{B.M.} = (P \cos \alpha_d + Q \sin \alpha_d)\, l_3$$

Arrangement 3

$$\left.\begin{array}{l} \text{Stock (lower)} \\ \text{Stock (upper)} \\ \text{Solepiece } (l_3) \end{array}\right\} \text{Force terms similar to arrangement 2}$$

Solepiece (l_4)

$$\text{B.M.} = (P \cos \alpha_d + Q \sin \alpha_d)$$

$$\left[l_3+l_4\left\{1-\frac{l_4{}^2}{E_4\,I_4}\left(\frac{\dfrac{l_3}{2}+\dfrac{l_4}{3}}{\dfrac{l_4{}^3}{3\,E_4\,I_4}+\dfrac{l_5{}^3}{3\,E_5\,I_5}}\right)\right\}\right]$$

Strut (l_5)

$$\text{B.M.} = (P \cos \alpha_d + Q \sin \alpha_d)$$

$$\left(\frac{\dfrac{l_3}{2}+\dfrac{l_4}{3}}{\dfrac{l_4{}^3}{3\,E_4\,I_4}+\dfrac{l_5{}^3}{3\,E_5\,I_5}}\right)\frac{l_4{}^2\,l_5}{E_4\,I_4}$$

Arrangement 4

$$\left.\begin{array}{l} \text{Stock (lower)} \\ \text{Stock (upper)} \\ \text{Solepiece } (l_3) \end{array}\right\} \text{Force terms similar to Arrangement 2}$$

Strut (l_5)

$$\text{B.M.} = (P \cos \alpha_d + Q \sin \alpha_d)\, l_5$$

$$\text{Torque} = (P \cos \alpha_d + Q \sin \alpha_d)\, l_3$$

Arrangement 5

Stock (lower)
Stock (upper)   Force terms similar to Arrangement 2
Solepiece (l_3)

Solepiece (l_4)

$$\text{B.M.} = (P \cos \alpha_d + Q \sin \alpha_d)\, l_3$$

Strut (l_5)

$$\text{B.M.} = (P \cos \alpha_d + Q \sin \alpha_d)\left(\frac{l_3 + l_4}{l_4}\right) l_5$$

Strut (l_6)

$$\text{B.M.} = (P \cos \alpha_d + Q \sin \alpha_d)\,\frac{l_3\, l_6}{l_4}$$

For stocks that are extremely stout relative to their effective bending length the axial loading case $\alpha_d = 0°$; $V = 0$ should be considered as well as the side load case.

Internal forces in the duct are given for both side and vertical loading cases.

Both cases are divided into two groups, resultant loading and self balancing loading. (Ref. Fig. 13.)

If the duct load is considered to be equally shared by both sides then only resultant loading needs to be considered. If on the other hand loading is considered to act on one side of the duct only, then the addition of the self balancing loading is required in full. The proportion of loading per side is extremely difficult to calculate on a generalised basis as extraneous effects such as after body shape and proximity play a part in determining such proportions as well as the duct geometry.

However, in order to obtain reasonable conservative internal forces, it is suggested that a one-third–two-thirds distribution be used until sufficient test or trials data becomes available to determine such distributions with greater accuracy.

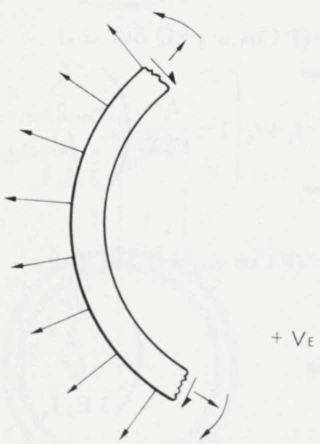


FIG. 15

Duct ring sign convention.

Referring to Fig. 15 which gives duct load sign convention, the internal forces are given by:—

Resultant side loading

$$\text{E.L.} = P\left(\frac{2}{\pi}\sin\phi + \frac{\cos\phi}{2}\right) - \frac{N}{2\pi}\left(\frac{\sin\phi}{2} + \phi\cos\phi\right)$$

$$\text{S.F.} = P\left(\frac{2}{\pi}\cos\phi - \frac{\sin\phi}{2}\right) - \frac{N}{2\pi}\left(\frac{3}{2}\cos\phi - \phi\sin\phi\right)$$

$$\text{B.M.} = R\left\{P\left(\frac{2}{\pi}\sin\phi + \frac{\cos\phi}{2} - \frac{1}{2}\right) - \frac{N}{2\pi}\left(\frac{\sin\phi}{2} + \phi\cos\phi\right)\right\}$$

Self balancing side loading

$$\text{E.L} = \frac{N}{2\pi}\left(\sin\phi - \phi\cos\phi + \frac{\pi}{2}\cos\phi\right)$$

$$\text{S.F.} = \frac{N}{2\pi}\left(\phi\sin\phi - \frac{\pi}{2}\sin\phi\right)$$

$$\text{B.M.} = \frac{R\,N}{2\pi}\left(\sin\phi - \phi\cos\phi + \frac{\pi}{2}\cos\phi - \frac{4}{\pi}\right)$$

Resultant vertical loading

$$\text{Upper quadrant E.L.} = \frac{N}{2\pi}\left(-\frac{\sin\theta}{2} + \theta\cos\theta + \frac{\pi}{2}\cos\theta\right)$$

$$\text{Upper quadrant S.F.} = \frac{N}{2\pi}\left(\theta\sin\theta - \frac{\cos\theta}{2} + \frac{\pi}{2}\sin\theta\right)$$

$$\text{Upper quadrant B.M.} = \frac{R\,N}{2\pi}\left(\frac{\sin\theta}{2} - \theta\cos\theta - \frac{\pi}{2}\cos\theta + 1\right)$$

$$\text{Lower quadrant E.L.} = \frac{N}{2\pi}\left(\frac{\sin\theta}{2} - \theta\cos\theta + \frac{\pi}{2}\cos\theta\right)$$

$$\text{Lower quadrant S.F.} = \frac{N}{2\pi}\left(\theta\sin\theta - \frac{\pi}{2}\sin\theta - \frac{\cos\theta}{2}\right)$$

$$\text{Lower quadrant B.M.} = \frac{R\,N}{2\pi}\left(\frac{\sin\theta}{2} - \theta\cos\theta + \frac{\pi}{2}\cos\theta - 1\right)$$

Self balancing vertical loading

$$\text{Both quadrants E.L.} = \frac{N}{2\pi}\left(\sin\theta - \theta\cos\theta + \frac{\pi}{2}\cos\theta\right)$$

$$\text{Both quadrants S.F.} = \frac{N}{2\pi}\left(\theta\sin\theta - \frac{\pi}{2}\sin\theta\right)$$

$$\text{Both quadrants B.M.} = \frac{R\,N}{2\pi}\left(\sin\theta - \theta\cos\theta + \frac{\pi}{2}\cos\theta - \frac{4}{\pi}\right)$$

Duct chordwise diaphragms and ring webs should be the same thickness as the outer plating.

Nose plating should be 25 per cent greater in thickness than the outer plating.

In way of couplings and heel pintles the local structure should be suitably increased in thickness.

For connections of the diaphragms and webs to the side plating and the welding methods and details reference should be made to the rule requirements for conventional rudders. The rule requirements should also be used with respect to drainage and coatings.

In the case of the stock thrust bearing this should be adequate for the duct design vertical loading.

4.4 Fixed ducts

Fixed ducts are usually supported by either a single substantial strut or bracket arrangement at the top of the duct or

by top and bottom supports both fully built into the duct and sternframe structure.

In the case of the single top support, the internal load distribution would be distributed in a manner similar to that applicable to a steerable duct (Arrangement 1).

Where the duct is supported at both the top and bottom positions, additional internal forces are caused and the solutions to these are given in the Appendix.

Geometry and load sign convention are given by Fig. 16.

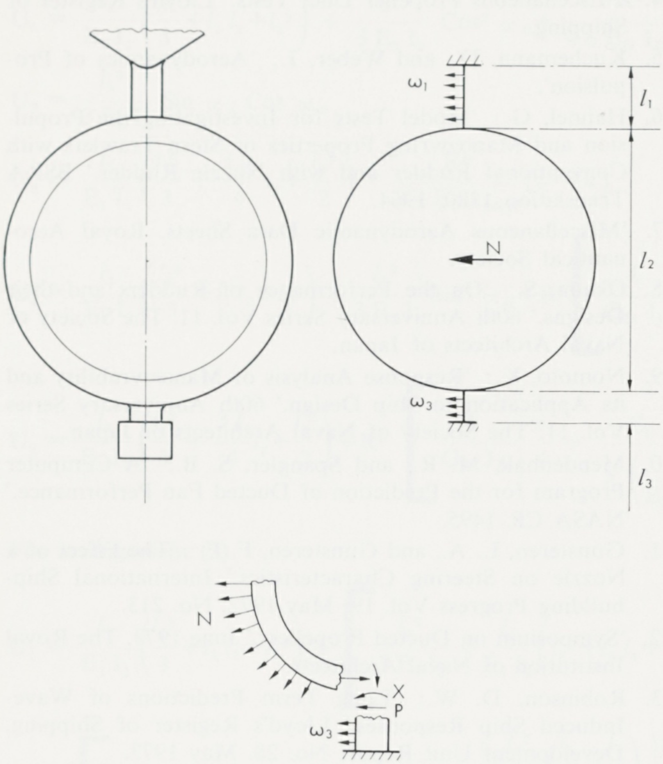


FIG. 16

Fixed duct load sign convention.

Strut (upper)

$$\text{B.M.} \quad = N\left(l_1 + \frac{l_2}{2}\right) - P\,(l_1 + l_2) + X + \frac{w_1\, l_1^2}{2}$$

$$\text{Torque} = \frac{N l_r + M_F}{2}$$

Strut (lower)

$$\text{B.M.} \quad = P\, l_3 + X + \frac{w_3\, l_3^2}{2}$$

$$\text{Torque} = \frac{N l_r + M_F}{2}$$

Duct

Resultant side loading

$$\text{E.L.} = P\left(\frac{2}{\pi}\,\text{Sin}\,\phi + \frac{\text{Cos}\,\phi}{2}\right) - \frac{N}{2\,\pi}\left(\phi\,\text{Cos}\,\phi + \frac{\text{Sin}\,\phi}{2}\right) - \frac{2\,X}{\pi\,R}\,\text{Sin}\,\phi$$

$$\text{S.F.} \; = P\left(\frac{2}{\pi}\,\text{Cos}\,\phi - \frac{\text{Sin}\,\phi}{2}\right) - \frac{N}{2\,\pi}\left(\frac{3}{2}\,\text{Cos}\,\phi - \phi\,\text{Sin}\,\phi\right) - \frac{2\,X}{\pi\,R}\,\text{Cos}\,\phi$$

$$\text{B.M.} = R\left\{P\left(\frac{2}{\pi}\,\text{Sin}\,\phi + \frac{\text{Cos}\,\phi}{2} - \frac{1}{2}\right) - \frac{N}{2\,\pi}\left(\frac{\text{Sin}\,\phi}{2} + \phi\,\text{Cos}\,\phi\right) - \frac{X}{R}\left(\frac{2}{\pi}\,\text{Sin}\,\phi - \frac{1}{2}\right)\right\}$$

Self balancing side loading

$$\text{E.L.} = \frac{N}{2\,\pi}\left(\text{Sin}\,\phi - \phi\,\text{Cos}\,\phi + \frac{\pi}{2}\,\text{Cos}\,\phi + 0{\cdot}64\,\text{Sin}\,\phi\right)$$

$$\text{S.F.} \; = \frac{N}{2\,\pi}\left(\phi\,\text{Sin}\,\phi - \frac{\pi}{2}\,\text{Sin}\,\phi + 0{\cdot}64\,\text{Cos}\,\phi\right)$$

$$\text{B.M.} = \frac{R\,N}{2\,\pi}\left(\text{Sin}\,\phi - \phi\,\text{Cos}\,\phi + \frac{\pi}{2}\,\text{Cos}\,\phi + 0{\cdot}64\,\text{Sin}\,\phi - 1{\cdot}68\right)$$

Resultant vertical loading

$$\text{E.L.} = \frac{N}{2\,\pi}\left(\text{Sin}\,\theta - \frac{\theta\,\text{Cos}\,\theta}{2}\right)$$

$$\text{S.F.} \; = \frac{N}{2\,\pi}\left(\theta\,\text{Sin}\,\theta - \frac{\text{Cos}\,\theta}{2}\right)$$

$$\text{B.M.} = \frac{R\,N}{2\,\pi}\left(-\,\theta\,\text{Cos}\,\theta + \frac{\text{Sin}\,\theta}{2}\right)$$

Self balancing vertical loading

$$\text{E.L.} = \frac{N}{2\,\pi}\left(\text{Sin}\,\theta - \theta\,\text{Cos}\,\theta + 0{\cdot}245\,\text{Cos}\,\theta\right)$$

$$\text{S.F.} \; = \frac{N}{2\,\pi}\left(\theta\,\text{Sin}\,\theta - 0{\cdot}245\,\text{Sin}\,\theta\right)$$

$$\text{B.M.} = \frac{R\,N}{2\,\pi}\left(\text{Sin}\,\theta - \theta\,\text{Cos}\,\theta + 0{\cdot}245\,\text{Cos}\,\theta - 0{\cdot}61\right)$$

In order to illustrate the difference in magnitude between duct ring B.Ms. caused by side and vertical loading an example of B.Ms. resulting from each type of case is given in Fig. 17.

A steerable duct incorporating a conventional pintle arrangement which allows some vertical float is also considered in Fig. 17 to draw attention to the large increase in B.Ms. that can result from this type of arrangement.

When restricting allowable stresses to the suggested limits duct deflection relative to the propeller tips is not normally a problem. If, however, the duct is graded in plate thickness to just accommodate local B.Ms. or the sternframe arrangement appears to be unduly flexible, even though allowable stress levels are fully satisfied, a check should be made on this aspect.

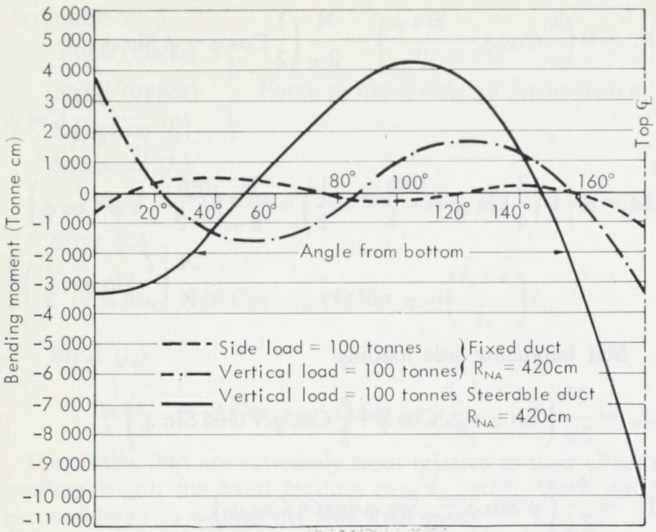


FIG. 17

Comparison of duct B.M's.

5.0 CONCLUSION

In the study of structurally critical duct loading it became evident in the very early stages that there was surprisingly little relevant test and trials data on this subject although quite a lot of literature exists regarding duct propulsive efficiency aspects.

Much more experimental information is required about such aspects as the effects of varying propeller loading, duct aspect ratio, fins, rudders in close proximity, hull interference, etc.

Additional data is also required with respect to duct forces due to ship's motions as vertical loading which arises from these motions often provides the critical loading case for the duct structure.

The existence of very large fixed ducts is, however, a fact, and very large steerable ducts could be in use in the near future necessitating current methods of analysis.

On this basis and until sufficiently hard experimental data is available it is hoped that the loading predictions which are based partly upon experimental data and partly upon theoretical calculations could help to supplement the methods of analysis in use by the Society.

Not all of this needed experimental data could be given reliably by model tests and the period required to accumulate such information could be a long one.

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Plates 1, 2 and 3 have been published by kind permission of Willi Becker, Ingenieubüro, Hamburg.

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8.0 APPENDIX

For all Steerable Duct Arrangements

$$P = \frac{U_3\,U_4\,N - U_2\,U_5\,T}{U_1\,U_4 - U_2^2} \qquad \text{and} \qquad Q = \frac{U_2\,U_3\,N - U_1\,U_5\,T}{U_2^2 - U_1\,U_4}$$

Where for arrangement (2)

$$U_1 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + l_1\,l_2 + l_2^2\right) + \frac{l_3^3}{3\,E_3\,I_3}\,\mathrm{Cos}^2 \propto_d + \frac{R^3}{4\,\pi\,E_D\,I_{DXX}}\left(3\,\pi^2 - 16\right)$$

$$U_2 = \frac{l_3^3}{3\,E_3\,I_3}\,\mathrm{Sin} \propto_d \mathrm{Cos} \propto_d$$

$$U_3 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + \frac{3\,l_1}{4}\,l_2 + \frac{l_2^2}{2}\right) + \frac{R^3}{8\,\pi\,E_D\,I_{DXX}}\left(\pi^2 + 4\right)$$

$$U_4 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + l_1\,l_2 + l_2^2\right) + \frac{l_3^3}{3\,E_3\,I_3}\,\mathrm{Sin}^2 \propto_d + R^3\left[\frac{1}{G_D\,J_D}\left\{\frac{3\,\pi}{4} - \frac{\dfrac{4}{G_D\,J_D}}{\pi\left(\dfrac{1}{E_D\,I_{DYY}} + \dfrac{1}{G_D\,J_D}\right)}\right\} + \frac{\pi}{4\,E_D\,I_{DYY}}\right]$$

$$U_5 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + \frac{3\,l_1}{4}\,l_2 + \frac{l_2^2}{2}\right) + R^3\left[\frac{1}{G_D\,J_D}\left\{\frac{\pi}{4} + \frac{\dfrac{1}{E_D\,I_{DYY}} - \dfrac{1}{G_D\,J_D}}{\pi\left(\dfrac{1}{E_D\,I_{DYY}} + \dfrac{1}{G_D\,J_D}\right)}\right\} + \frac{1}{\pi\,E_D\,I_{DYY}}\right]$$

For arrangement (3)

$$U_1 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + l_1\,l_2 + l_2^2\right) + \left[\frac{l_3^3}{3\,E_3\,I_3} + \frac{l_4}{E_4\,I_4}\left(l_3^2 + l_3\,l_4 + \frac{l_4^2}{3}\right) - 3\,\frac{\left\{\dfrac{l_4^2}{E_4\,I_4}\left(\dfrac{l_3}{2} + \dfrac{l_4}{3}\right)\right\}^2}{\dfrac{l_4^3}{E_4\,I_4} + \dfrac{l_5^3}{E_5\,I_5}}\right]\mathrm{Cos}^2 \propto_d + \frac{R^3}{4\,\pi\,E_D\,I_{DXX}}\left(3\,\pi^2 - 16\right)$$

$$U_2 = \left[\frac{l_3^3}{3\,E_3\,I_3} + \frac{l_4}{E_4\,I_4}\left(l_3^2 + l_3\,l_4 + \frac{l_4^2}{3}\right) - 3\,\frac{\left\{\dfrac{l_4^2}{E_4\,I_4}\left(\dfrac{l_3}{2} + \dfrac{l_4}{3}\right)\right\}^2}{\dfrac{l_4^3}{E_4\,I_4} + \dfrac{l_5^3}{E_5\,I_5}}\right]\mathrm{Sin} \propto_d \mathrm{Cos} \propto_d$$

$$U_3 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + \frac{3}{4}\,l_1\,l_2 + \frac{l_2^2}{2}\right) + \frac{R^3}{8\,\pi\,E_D\,I_{DXX}}\left(\pi^2 + 4\right)$$

$$U_4 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + l_1\,l_2 + l_2^2\right) + \left[\frac{l_3^3}{3\,E_3\,I_3} + \frac{l_4}{E_4\,I_4}\left(l_3^2 + l_3\,l_4 + \frac{l_4^2}{3}\right) - 3\,\frac{\left\{\dfrac{l_4^2}{E_4\,I_4}\left(\dfrac{l_3}{2} + \dfrac{l_4}{3}\right)\right\}^2}{\dfrac{l_4^3}{E_4\,I_4} + \dfrac{l_5^3}{E_5\,I_5}}\right]\mathrm{Sin}^2 \propto_d$$
$$+ R^3\left[\frac{1}{G_D\,J_D}\left\{\frac{3\,\pi}{4} - \frac{\dfrac{4}{G_D\,J_D}}{\pi\left(\dfrac{1}{E_D\,I_{DYY}} + \dfrac{1}{G_D\,J_D}\right)}\right\} + \frac{\pi}{4\,E_D\,I_{DYY}}\right]$$

$$U_5 = \frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3} + \frac{3}{4}\,l_1\,l_2 + \frac{l_2^2}{2}\right) + R^3\left[\frac{1}{G_D\,J_D}\left\{\frac{\pi}{4} + \frac{\dfrac{1}{E_D\,I_{DYY}} - \dfrac{1}{G_D\,J_D}}{\pi\left(\dfrac{1}{E_D\,I_{DYY}} + \dfrac{1}{G_D\,J_D}\right)}\right\} + \frac{1}{\pi\,E_D\,I_{DYY}}\right]$$

In order to take account of torsional stiffness put values of l_4 l_5 as 0·9 actual lengths in arrangement (3).

For arrangement (4)

$$U_1 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+l_1 l_2+l_2^2\right)+l_5\left(\frac{l_5^2}{3 E_5 I_5}+\frac{l_3^2}{G_5 J_5}\right)\mathrm{Cos}^2 \propto_d+\frac{R^3}{4\pi E_D I_{DXX}}\left(3\pi^2-16\right)$$

$$U_2 = l_5\left(\frac{l_5^2}{3 E_5 I_5}+\frac{l_3^2}{G_5 J_5}\right)\mathrm{Sin} \propto_d \mathrm{Cos} \propto_d$$

$$U_3 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+\frac{3}{4} l_1 l_2+\frac{l_2^2}{2}\right)+\frac{R^3}{8\pi E_D I_{DXX}}\left(\pi^2+4\right)$$

$$U_4 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+l_1 l_2+l_2^2\right)+l_5\left(\frac{l_5^2}{3 E_5 I_5}+\frac{l_3^2}{G_5 J_5}\right)\mathrm{Sin}^2 \propto_d+R^3\left[\frac{1}{G_D J_D}\left\{\frac{3\pi}{4}-\frac{\frac{4}{G_D J_D}}{\pi\left(\frac{1}{E_D I_{DYY}}+\frac{1}{G_D J_D}\right)}\right\}+\frac{\pi}{4 E_D I_{DYY}}\right]$$

$$U_5 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+\frac{3 l_1}{4} l_2+\frac{l_2^2}{2}\right)+R^3\left[\frac{1}{G_D J_D}\left\{\frac{\pi}{4}+\frac{\frac{1}{E_D I_{DYY}}-\frac{1}{G_D J_D}}{\pi\left(\frac{1}{E_D I_{DYY}}+\frac{1}{G_D J_D}\right)}\right\}+\frac{1}{\pi E_D I_{DYY}}\right]$$

For arrangement (5)

$$U_1 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+l_1 l_2+l_2^2\right)+\left\{\frac{l_3^3}{E_3 I_3}+\frac{l_4^3}{E_4 I_4}\left(\frac{l_3}{l_4}\right)^2+\frac{l_5^3}{E_5 I_5}\left(\frac{l_3+l_4}{l_4}\right)^2+\frac{l_6^3}{E_6 I_6}\left(\frac{l_3}{l_4}\right)^2\right\}\frac{\mathrm{Cos}^2 \propto_d}{3}+\frac{R^3}{4\pi E_D I_{DXX}}\left(3\pi^2-16\right)$$

$$U_2 = \left\{\frac{l_3^3}{E_3 I_3}+\frac{l_4^3}{E_4 I_4}\left(\frac{l_3}{l_4}\right)^2+\frac{l_5^3}{E_5 I_5}\left(\frac{l_3+l_4}{l_4}\right)^2+\frac{l_6^3}{E_6 I_6}\left(\frac{l_3}{l_4}\right)^2\right\}\frac{\mathrm{Sin} \propto_d \ \mathrm{Cos} \propto_d}{3}$$

$$U_3 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+\frac{3 l_1}{4} l_2+\frac{l_2^2}{2}\right)+\frac{R^3}{8\pi E_D I_{DXX}}\left(\pi^2+4\right)$$

$$U_4 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+l_1 l_2+l_2^2\right)+\left\{\frac{l_3^3}{E_3 I_3}+\frac{l_4^3}{E_4 I_4}\left(\frac{l_3}{l_4}\right)^2+\frac{l_5^3}{E_5 I_5}\left(\frac{l_3+l_4}{l_4}\right)^2+\frac{l_6^3}{E_6 I_6}\left(\frac{l_3}{l_4}\right)^2\right\}\frac{\mathrm{Sin}^2 \propto_d}{3}$$
$$+R^3\left[\frac{1}{G_D J_D}\left\{\frac{3\pi}{4}-\frac{\frac{4}{G_D J_D}}{\pi\left(\frac{1}{E_D I_{DYY}}+\frac{1}{G_D J_D}\right)}\right\}+\frac{\pi}{4 E_D I_{DYY}}\right]$$

$$U_5 = \frac{l_1}{E_1 I_1}\left(\frac{l_1^2}{3}+\frac{3 l_1}{4} l_2+\frac{l_2^2}{2}\right)+R^3\left[\frac{1}{G_D J_D}\left\{\frac{\pi}{4}+\frac{\frac{1}{E_D I_{DYY}}-\frac{1}{G_D J_D}}{\pi\left(\frac{1}{E_D I_{DYY}}+\frac{1}{G_D J_D}\right)}\right\}+\frac{1}{\pi E_D I_{DYY}}\right]$$

In order to take account of torsional stiffness put values of l_4, l_5, l_6 as 0·9 of actual lengths in arrangement (5).

For fixed duct arrangement

$$P=\frac{(U_3\,U_4-U_2\,U_5)\,N+(U_4\,U_6-U_2\,U_8)\,\omega_1+(U_4\,U_7-U_2\,U_9)\,\omega_3}{U_1\,U_4-U_2^2}$$

$$X=\frac{(U_2\,U_3-U_1\,U_5)\,N+(U_2\,U_6-U_1\,U_8)\,\omega_1+(U_2\,U_7-U_1\,U_9)\,\omega_3}{U_2^2-U_1\,U_4}$$

Where

$$U_1=\frac{l_1}{E_1\,I_1}\left(\frac{l_1^2}{3}+l_1\,l_2+l_2^2\right)+\frac{l_3^3}{E_3\,I_3}+\frac{R^3}{4\,\pi\,E_D\,I_{DXX}}\left(3\,\pi^2-16\right)$$

$$U_2=\frac{-l_1}{E_1\,I_1}\left(\frac{l_1}{2}+l_2\right)+\frac{l_3^2}{2\,E_3\,I_3}+\frac{R^2}{2\,\pi\,E_D\,I_{DXX}}\left(8-\pi^2\right)$$

$$U_3=\frac{l_1}{E_1\,I_1}\left(\frac{l_2^2}{2}+\frac{3\,l_1}{4}\,l_2+\frac{l_1^2}{3}\right)+\frac{R^3}{8\,\pi\,E_D\,I_{DXX}}\left(\pi^2+4\right)$$

$$U_4=\frac{l_1}{E_1\,I_1}+\frac{l_3}{E_3\,I_3}+\frac{R}{\pi\,E_D\,I_{DXX}}\left(\frac{\pi^2}{2}-4\right)$$

$$U_5=\frac{-l_1}{2\,E_1\,I_1}\left(l_1+l_2\right)-\frac{R^2}{2\,\pi\,E_D\,I_{DXX}}$$

$$U_6=\frac{l_1}{E_1\,I_1}\left(\frac{l_1^2\,l_2}{6}+\frac{l_1^3}{8}\right)$$

$$U_7=\frac{l_3^4}{8\,E_3\,I_3}$$

$$U_8=\frac{-l_1^3}{6\,E_1\,I_1}$$

$$U_9=\frac{-l_3^3}{6\,E_3\,I_3}$$

If the arrangement is built entirely of one type of material E can be ignored and G given appropriate proportional value (i.e. for steel $G=0{\cdot}4$).

9.0 GLOSSARY OF TERMS

- A_d Side area of duct
- A_s Cross sectional area of duct
- A_f Side area of fin
- A_r Side area of isolated rudder
- a Length of aft portion of triangular portion of fin
- b Length of forward portion of triangular portion of fin
- C_b Block coefficient
- C_D Drag coefficient
- C_L Lift coefficient
- C_N Normal force coefficient
- $C_N max$ Maximum normal force coefficient
- C_{Td} Axial force coefficient
- CP Centre of pressure
- c Gap between duct trailing edge and rudder leading edge
- D Duct internal diameter
- ds Peripheral distance of duct cross section
- E Young's modulus
- e Width of plate between ring webs
- F_d Radial loading
- G Shear modulus
- H_d Overall thickness of duct section at propeller disc position
- h Height of triangular portion of fin
- I_1 Second moment of area about stock diameter
- I_3 Second moment of area of solepiece (l_3) about vertical centreline
- I_4 Second moment of area of solepiece (l_4) about vertical centreline
- I_5 Second moment of area of aft strut (l_5) about vertical centreline
- I_6 Second moment of area of forward strut (l_6) about vertical centreline
- I_{DXX} Second moment of area of duct cross section about chordwise line
- I_{DYY} Second moment of area of duct cross section about axis normal to chordwise line
- J Propeller advance coefficient
- J_D Torsion constant of duct cross section
- J_5 Torsion constant of aft strut (l_5)
- K_1 Curved plate effective width efficiency factor
- K_2 Constant of generalised duct sectional property I_{DXX}
- K_3 Constant of generalised duct sectional property I_{DYY}
- K_4 Constant of generalised duct sectional property J_D
- K_{TD} Duct thrust coefficient
- K_{TT} Total thrust coefficient
- L_d Chord length of duct
- L_s Chord length of strut
- LBP Length between perpendiculars (metres)
- l_1 Length of stock effective in bending
- l_2 Distance between stock coupling and pintle bearing
- l_3 Length of aft portion of solepiece
- l_4 Length of forward portion of solepiece
- l_5 Length of aft strut
- l_6 Length of forward strut
- l_a Distance between fin trailing edge and duct trailing edge
- l_f Chord length of fin
- l_r Distance between leading edge of duct and flexural centre of strut
- l_s Distance between leading edge of duct and stock. For fixed ducts between L.E. and propeller position
- l_t Distance between leading edge of duct and leading edge of triangular portion of fin
- M_{ds} Steerable duct torque about stock due to duct only
- M_f Steerable duct torque about stock due to fin only
- M Steerable duct total torque about stock
- M_{dl} Fixed duct torque about leading edge due to duct only
- M_{dr} Fixed duct torque about leading edge due to isolated rudder
- M_F Total fixed duct torque about leading edge
- N Total normal force on duct arrangement
- N_d Normal force on duct due to duct only
- N_f Normal force on duct due to fin
- N_{f1} Normal force on duct due to rectangular part of fin
- N_{f2} Normal force on duct due to triangular part of fin
- N_{dr} Normal force on duct due to isolated rudder
- N_r Normal force on isolated rudder
- P Pintle reaction force normal to duct axis
- Q Pintle reaction force parallel to duct axis
- R Radius of duct neutral axis
- T_d Duct axial load
- t Thickness of duct plating
- V Effective free stream speed before wake correction
- V_a Speed of advance
- V_{ad} Local speed of advance
- V_e Exit speed
- V_s Maximum service speed
- w_1 Distributed side loading on fixed duct upper strut
- w_3 Distributed side loading on fixed duct lower strut
- w_t Taylor wake fraction
- X Internal moment at top of fixed duct lower strut
- α_d Duct angle of attack
- $\alpha_d C_N max$ Angle of attack at which $C_N max$ occurs
- β_R Drift angle at rudder position
- η Efficiency factor
- ρ Mass density

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LLOYD'S REGISTER AND THE SHIPBUILDER

A. R. Belch

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FOR PRIVATE CIRCULATION AMONGST THE STAFF ONLY

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LLOYD'S REGISTER AND THE SHIPBUILDER

by A. R. BELCH

Managing Director, Scott Lithgow Ltd.

When I was asked to write this paper I was told that this was a new idea on the part of the Association to ask people outside Lloyd's Register who have dealt with the Society over the years, to say what was thought about the Society and to be as constructively or destructively critical as I wanted. I think this is a bit unfair and I hope that the Members of the Association will feel ready to be equally critical of the shipbuilder and particularly the British shipbuilder, because I know that there is a lot to be learned from bodies such as Lloyd's Register who can look objectively at what we the shipbuilders are trying to do and who are better placed than we are, from their particular vantage point, to see the wood from the trees.

I must say, as I came up against the deadline for writing this paper, that I deeply regretted having agreed to do so, because my association with Lloyd's Register in more recent times has been increasingly limited to those occasional meetings of the Scottish Committee, and now of the General Committee in London, where I meet a lot of friends, have interesting discussions (and excellent lunches), but where we do not always get down to the 'nitty-gritty' stuff which I may be expected to talk about. However, in our organisation we have a lot of people who are dealing with the Society daily in all its aspects, and I have, in turn, press-ganged them into one or two meetings with me in recent weeks to get their general views on the Society's operations and how we might both benefit from many years of experience of working together. I received such helpful comments from some of my colleagues as 'building a ship is like running an obstacle race and all I can say is that Lloyd's Register is one of the least obstacles that we have to surmount!' Or, 'You know it is quite easy. The Surveyors are really very good chaps and very helpful—that's all you really need to say'.—All good stuff that was very useful to me in trying to write a paper which had to last for about three-quarters of an hour! Finally, after a great deal of thrashing around on how I would approach this paper, I decided that it really could not be a very erudite treatise but that it would probably be preferred if I dealt with the subject in a very informal way. I therefore asked the President of the Association for some idea of the kind of topics and questions that I might be expected to touch on, and he very kindly set down 20 searching questions. It seemed to me that the best thing would be to take them one by one and give the concerted views of my Scott Lithgow colleagues and myself on the queries which were raised. So I hope I will be forgiven if this paper to some extent turns into a question and answer session, but I think that in this way I will cover the whole subject more comprehensively.

Question No. 1: Are the classification societies necessary?

The answer to this must be a very clear 'Yes'. From my technical colleagues comes the statement that the classification societies are completely indispensable. What a change of view from the shipbuilder's letter written to the Society in 1864 taken from a recent Presidential Address to the Institution of Engineers and Shipbuilders in Scotland. It reads:—

> 'I return tracing of new vessel—what intercostal keelsons can be required for is more than I can understand and, unless you can prove a necessity for them, I will not be disposed to fit them as they are very expensive—and certainly not required for the strength of vessel. The Bulb iron in side stringer is also unnecessary, and the doubling of upper sheerstrake. Hold stancheons of course I will fit in proportion to the weight the decks will have to carry, etc.
>
> I write you this because it appears to me wrong that your officers should alter our well prepared plans without giving us at least sound reasons for so doing, and by inference makes our knowledge inferior to theirs. This cannot be the case, and if shipbuilding is to be properly carried on, each ship must be designed for the purpose she is intended and cannot be regulated by sumptuary laws.
>
> I trust you will see that this letter does not arise from any disposition to dispute but from a sincere desire to show where a grievance exists between your Society and the numerous scientific men who are now engaged in iron shipbuilding.'

But a very different view of Lloyd's Register is held today. In a highly competitive international industry like shipbuilding it is essential that we shipbuilders build as far as possible to common and acceptable standards and that we know what these standards are. It is equally essential that ships are built to sound minimum standards for insurance purposes, and I consider that the whole committee structure of Lloyd's Register, bringing in, as it does, the views of all parties—shipbuilders, shipowners, insurance underwriters, and so on—ensures that the standards to which we have to build under its Rules are properly determined by the joint experience of all the different parties concerned.

It is equally important for the shipbuilder that he also has somebody impartial like the LR Surveyor to act as the arbiter in the occasional dispute on technical matters which can arise between shipbuilder and shipowner. We certainly always insist in our shipbuilding contracts that Lloyd's Register act as the sole arbiters, and we have seldom found that the shipowner objects to this procedure. I am always amazed that the Society has been able to preserve its complete impartiality in any technical dispute, even though one would have thought that the Surveyor, being stationed for long periods of time in particular shipyards building for a number of different owners, would at times have found it difficult to be completely impartial.

There are those of my colleagues who have expressed the view that one of the Society's problems in the future will be the recruitment of sufficiently experienced practical personnel, since in the past these have mainly come from British shipbuilding industry's drawing offices and the ranks of the shipyard production managers—two groups of people who unfortunately have been tending to shrink in recent years with the reduction in the number of British shipbuilding establishments. However, despite the gloomy prognostications of so

many people in this country, I believe that the British shipbuilding industry is on the threshold of a period of considerable expansion and we for one have never resented the fact that many of our best young people are recruited into Lloyd's Register. This type of cross-fertilisation is necessary and very healthy for both parties.

All in all, I cannot see any better alternative to the present arrangement of our classification societies. It is also healthy that there should be more than one and that there should be some element of competition in the field, although I have always respected the fact that Lloyd's Register has never been prepared to lower its standard to match those of certain other classification societies if they felt it was the incorrect thing to do. That is not to say that we as shipbuilders have not from time to time used every possible form of blackmail to try to make it do so! And there have been times, in my view, when the Society would not have moved so speedily or accepted some of our more reasonable proposals if it had not been stimulated to do so by the competition of another classification society. But even here it has always very wisely moved with caution and only after it has been satisfied that it was doing the correct thing.

I sometimes wonder whether it was better in the U.K. when there was both Lloyd's Register and the British Corporation. Would, for example, the Society have moved so speedily into research on welded structures if it had not been stimulated to do so by the undoubted lead which the British Corporation at one time had in that field? Having said, however, that competition between the classification societies is a good and healthy thing, I would nevertheless suggest that it would be in the best interests of international shipping and shipbuilding if our various classification societies were able to find a satisfactory formula for closer co-operation on certain basic fundamentals of ship design and construction.

Question No. 2: What influence does the Lloyd's Register Surveyor have in the shipyard?

The answer to that question clearly depends on the individual Surveyor. His influence can be considerable and extremely good if he is a man with sound practical experience who knows his job and clearly demonstrates by his attitude and approach that he is as good, if not better than, the people he is working with. He must also be a team man with a broad outlook and the ability to get on with people, qualities which are not always easy to find. We have, over the years, had experience of many very good Surveyors who had all these attributes. However, we have very occasionally experienced others who, usually due to their lack of experience, have been obstructive and petty-minded not having the breadth of vision to realise that perfection is not possible in any world of human beings. Very often the remedying of small mistakes and omissions can result in a worse job at the end of the day. To be lucky enough to have a sound, practical and experienced Surveyor with the ability to get on with the shipbuilding team and with the shipowners' representatives, is indeed fortunate. He can help considerably to improve the efficiency of the shipyard and can assist greatly in welding owners and builders together to the ultimate benefit of the ship as a whole. One of the greatest problems we face today is the fact that all too often a Surveyor gains experience, becomes part of a shipbuilding team and is truly a very effective instrument in the whole machine when he is whipped away to some other job and we shipbuilders have to start all over again. Certainly we recognise that we must never stand in the way of Surveyors gaining additional experience or obtaining their due promotion, but it would be helpful if more notice was given of change and if there was an overlapping period when a Surveyor, experienced in a particular shipbuilding establishment, would have the time to guide his successor into a sound knowledge of the personnel and construction methods of the establishment which he had just joined.

The local Surveyor can be a very important link in the line of communication with the Society's headquarters, and my colleagues and I consider that at times more responsibility should be given to the local man to make both practical and technical descisions on the spot rather than having too much reference back to 'headquarters', although I appreciate that fundamental technical decisions must be made in London. Likewise, we consider that it would be advantageous for all concerned if 'headquarters' could from time to time visit the various shipbuilding centres and spend some time 'on the shop floor' discussing with the local Surveyors and the shipbuilding management the practical difficulties which arise in the day-to-day building of ships in a modern shipyard. I appreciate, of course, that 'headquarters' is staffed by many people who have had considerable experience in the field but I would like to see them continue to maintain this close liaison with the 'coal face'.

Question No. 3: Lloyd's Register's previous philosophy was 'You design it and then we'll approve it'. That is, it followed rather than led new developments. In its new role of trying to stimulate progress in the marine field, is the Society far enough ahead?

The new basis of approach is, in our view, a very much better one, since Lloyd's Register has built up over the years a fund of information from practical experience and in many respects are in a better position than the shipbuilder to lead in the field of new design, particularly in special ship types such as chemical tankers, LNG, LPG, container ships, offshore oil structures, etc. In fairness, it will need a lot of money to take a more active lead in these fields and some consideration might be given to the possibility of Government, owners and builders helping to finance such efforts; here, of course, we are up against the basic problem that Lloyd's Register is an international organisation and the result of its researches have, of necessity, to be made available across the whole international field. Nevertheless, I get the impression today that we are seeing a real effort on the part of the Society to take the lead in the design of new ship types, and I would very much like to see this trend encouraged by all parties.

We particularly welcome Lloyd's Register's new integrated structural analysis and design system, which enables the ship designer to incorporate the Society's philosophy into his plans from the start, freeing him from the rigidity of published rules and at the same time allowing him to exercise his own skills within the Society's controlled restraints.

It is probably worth mentioning that we at Scott Lithgow, particularly in recent times, have had excellent experience with our designers working at the Society's headquarters in London along with the Surveyors in the initial preparation of structural drawings for certain ships to be built in our shipyards. This is a very useful co-operative arrangement, and the type of commercial cross-fertilisation which is a feature of the modern Lloyd's Register and which we greatly welcome.

Question No. 4: Are there any new areas that the Society should become interested in? *e.g.* (a) *Total Transport systems*:—

Possibly Lloyd's Register could do a great deal in the field of the total transport system, but this would be a very major project and one which would continuously vary according to the type of goods to be transported, the methods of transportation involved and the distribution requirements from initial production to ultimate distribution. In my view, not sufficient research has been done into total transport systems but, because there can be no such system which is common to all the varying requirements, I cannot see how the Society can do effective work in this field other than in the broadest and most general way.

(b) *Economics of shipbuilding*

Most certainly Lloyd's Register can assist greatly in the economics of practical shipbuilding. In this day and age, when the cost of a man-hour is increasing at such a rate, design for the most efficient production is all-important. For example, in the field of structures, for far too long there has been a fetish for minimum scantlings and not enough attention has been paid to the practical production difficulties associated with any particular structure. We ourselves in recent times have added 1000 tonnes of steel to our standard 250 000-ton dwt VLCC by introducing asymmetrical face flats on transverses, etc., for ease of production in the fabrication hall, by the introduction of overlaps instead of butt joints, etc. We are satisfied that, despite the increasing cost of steel, we will so reduce our wages and overheads by our latest design that our total costs will be greatly reduced.

A 'clean' design of steel structure is also essential. For too long we have been designing and building 'bitsy' structures made up of lots of brackets, face flats, odd bits and pieces which create additional and unnecessary steelwork production costs; these can add up to as much as 50 per cent more than could be achieved with a structure designed for most efficient production. In this respect I am a particular advocate of the 'overlap' as against too much 'watch-making' in accurate butt jointing.

Lloyd's Register have a very considerable part to play in this field of design for production by establishing a closer working liaison with the individual shipyards and a clearer understanding of their production facilities and their practical production problems. This is a field in which we at Scott Lithgow are concentrating greatly at the present moment, and I must say that we are having considerable co-operation from the Society in our efforts. I am satisfied that proper design for production in our shipyards will yield cost reduction benefits far in excess of those we have so far obtained by the introduction of some of our most modern and sophisticated plant and machinery. In this respect, I would make a particular plea that our main concentration should be on design for production which will reduce the amount of work undertaken on the building berth or in the building dock, since it is our experience that, in this sphere of operation, there is by far the greatest wastage of man-hours.

(c) *Building for obsolescence*

I sincerely wish that Lloyd's Register could co-operate with us in some arrangement like the silk stocking manufacturers used to have—that a thread was introduced somewhere that went bust after about the tenth wearing! It would be ideal if all ships become totally obsolescent after about ten years. If so, we shipbuilders would have a very much happier existence. But, regrettably, this is not a practical propostion when the world of international shipping and shipbuilding is so highly competitive and when some owners are prepared to run their ships for an indefinite period to absolute minimum standards, whilst others adopt a totally different policy of turning their ships in after only five or six years of operation.

To plan effectively for ship obsolescence would require a degree of co-operation which is just not possible today and which has certainly not so far been evidenced in any other field of international activity.

(d) *Research into minimum building standards*

Minimum building standards, in my mind, can be clearly divided into standards of design, particularly structures design, and standards of workmanship.

So far as design of structures is concerned, clearly Lloyd's Register are ideally placed to stipulate minimum standards. It has a continual feed-back from ships in operation and is much better placed than the shipbuilder to assess from experience exactly what minimum scantlings can be allowed.

On the question of workmanship, a number of my colleagues have expressed the view to me that it would be of considerable advantage if we could have a uniform standard of requirement and that it would be a great help to shipbuilders to know that there was such an identifiable Lloyd's Register's standard. This, they suggest, might also help us to overcome certain problems such as those associated with the internal coating of tanks in product tankers, which we have recently experienced and where we believe that the standard of steelwork finish demanded by the owners and the painting sub-contractors was well above normal shipbuilding practice and certainly much in excess of the Society's requirements. Be that as it may, I personally think the task of setting down clearly identifiable standards of steelwork construction would be extremely difficult. I think we might well be hoisted on our own petard if we were to ask Lloyd's Register to state clearly in writing its requirements regarding such day-to-day production problems as wide shell or deck butts, fairing of uneven decks and bulkheads, undercutting, etc. These, as we all know, are matters which are still left to the judgement of the individual Surveyor and I think it is best that it should continue to be so. However, it might be helpful if Lloyd's Register itself did get its practical, experienced Surveyors together from time to time, which they may well do for all I know, so that there would be throughout the Society slightly more uniformity of approach to these day-to-day production problems which arise in our shipyards. Generally speaking, we have found that the Surveyor has been prepared to take a realistic, practical look at any production problem which may arise, and he and the owners' representative have almost invariably worked with us to overcome such difficulties in the most economic way, provided the job has been satisfactory at the end of the day. However, we do occasionally have difficult owners' representatives who seek perfection at times—we also have the occasional very demanding Surveyor, and it would be helpful if, at least behind the scenes, the Society did have certain basic standards of workmanship which it would regard as a minimum. In this connection I must say that certain of my colleagues hold the view, from what they have seen from certain foreign-built ships that there can at times be one law for the rich and one for the poor, and that foreign shipbuilders appear to get away with things which would not be

accepted from the British shipbuilder. In fairness, some of the ships we look at have not necessarily been built to the requirements of Lloyd's Register but nevertheless they seem to be operating satisfactorily.

(e) *Research into new materials*

Clearly the Society must always be actively researching into possible new materials for shipbuilding—special steels, fibreglass, plastics, concrete (particularly for offshore structures), etc. Here again it has a feed-back of information and behaviour which should enable it to lead the field in materials research. One important point worth stressing is that any practical application of new materials in shipbuilding must clearly be considered along with the commercial considerations, and this is obviously so with materials such as special steels, aluminium and fibreglass.

Another field in which the Society might usefully develop greater research in the future is in the field of paints. Painting has now become a major scientific study and, as we know, the modern epoxy painting systems have to leave a complete film over the whole steel structure. With corrosion control, Lloyd's Register of course has to ensure that the steel surfaces are properly coated and to the correct thickness, but it may be that the Society can in the future play a useful part in determining the qualities of various paints, the standards of steelwork finish required before their application and the particularly vexed question of prevailing weather conditions in this country.

However, we may talk of fibreglass, concrete and so on, but it does seem clear to me that, at least in this generation, there is unlikely to be any major substitute for steel as the principal material for ships' structures.

Question No. 5: Does the shipbuilder consider that the surveying staff is biased towards the owner?

In this connection one of my colleagues has commented 'It would be difficult to think of any other saleable article where the owner has so much influence on what he will ultimately have to accept'.

Clearly the owner's influence during the construction of a ship has been very important in the past. Today the trend appears to be moving away from having too many owners' representatives on the spot, and I particularly welcome the fact that, in recent contracts which we have negotiated, the owner does not propose to send any representative to stand by in our shipyard, but has arranged with the Society's Specification Services Department to act on his behalf for the approval of specifications, plans and the construction of his vessel. Although I appreciate that this particular department will work quite independently of the normal surveying staff, it is my hope that their common origin will ensure a uniform line of approach on many matters which should be to the ultimate advantage of both shipbuilder and shipowner.

I have to say that our general feeling is that it can sometimes be difficult for the Surveyor to be totally impartial, particularly when surveying ships for very substantial owners who have the ultimate decision as to which society they are going to use for the classification of their vessels. We ourselves have had examples of this where we believe that unrealistic standards have been requested by shipowners and insisted upon by the Surveyor.

Nevertheless, Lloyd's Register preserves a remarkable impartiality and it is of course essential that we have somebody to monitor our performance. I personally prefer to have a Surveyor who is 'on the ball' rather than the occasional one who takes life too easy—provided always that he is fair and impartial in all his dealings.

Question No. 6: Does the shipbuilder expect the local Surveyor to complement or supplement his quality control department?

There is no question in our mind that the Surveyor should complement our quality control department, which should be totally complete and sufficient in itself. Equally, it should not require supplementing by a Surveyor or anyone else. The Surveyor's essential function is to check that the quality achieved by the shipyard's own quality control meets the required standards. On the other hand, I am by no means an advocate of the Surveyor who expects 100 per cent perfection. I am equally not a supporter of the very occasional Surveyor who comes to take a survey and, if things are not perfect, may walk off the job with the message that he will return when everything is absolutely in first-class order. Essentially we come back to the basic team concept of the LR Surveyor, the shipowners' representative and the shipbuilder—hopefully all pulling in the same direction towards a better finished ship. I would, however, like to say that we are increasingly recognising that effective quality control is all-essential in modern shipbuilding. I have mentioned earlier the problems of work on the building berth and, if one is to minimise this work, it is essential that quality control is active from delivery of material into the yard until the prefabricated units are joined together on the building berth or in the building dock. I know that in our organisation we are by no means satisfied that our steelwork quality control on merchant ships is all that it should be and we are very conscious that considerable improvement is still needed and will result in very considerable cost savings. But, whatever we do with quality control, we must be careful that it does not become the tail that wags the dog, that we do not become smothered in paper and that we do not establish such rigid and inflexible control systems that production costs are adversely affected instead of considerably reduced which should be the principal aim of any effective merchant shipbuilding quality control system.

Question No. 7: Does Lloyd's Register set too high standards?

I would firstly state categorically that no standard can be too high when safety of life is concerned, but standards must be realistic in the context of international competitive shipbuilding.

On balance, I would not suggest that the Society's standards are too high, although they are clearly higher in many instances than other classification societies. The unfortunate thing is that there are different standards between different societies and different Surveyors, and I guess it will always be so. However, it is important that Lloyd's Register should apply the same standards internationally and that, as far as possible, they should try to enforce a uniform standard in their surveying both at home and abroad. We should not have to meet circumstances whereby a piece of foreign equipment is passed as satisfactory by a Surveyor abroad but rejected by another Surveyor when it has been delivered into our shipyard in the U.K.—something that has happened to us in the past. However, I know it is easy to pick out isolated incidents like this which are by no means the rule.

Question No. 8: Are most Surveyors sufficiently up-to-date on modern production methods and outfitting?

It is, of course, essential that Surveyors should be really up-to-date on modern production methods, the latest welding techniques, control engineering systems, etc. If they are stationed at modern progressive shipyards, I have no doubt that they are kept very much abreast of the times, but there must be many who are somewhat in the backwoods and clearly they must be given the opportunity, in some way or another, to update their knowledge and experience. I suppose that the Society must have a system of withdrawing their Surveyors from time to time to bring their training up-to-date and, as far as we are concerned, we would welcome any arrangement that might be suggested for taking certain of their Surveyors into our shipyards to study the methods that we are adopting. Equally, we would be happy to provide people to talk about our practical production problems at any discussion group that the Society may decide to run on this subject for their Surveyors in the future. In the same way we would always welcome Lloyd's Register at any of our own 'in-house' discussions on practical production problems. We have already found that the benefit of its experience can often be considerable.

Question No. 9: What is the ideal level for a Surveyor within the shipbuilder's command structure?

Obviously the Surveyor cannot lie within the shipbuilder's command structure. He is, and must remain, an independent operator. However, we have always regarded a Senior Surveyor as being the equivalent of one of our heads of department—the shipyard manager, the naval architect, the chief draughtsman, etc. Although, if he is a good operator, he is bound to work at times directly with the men, the foremen and assistant managers, he nevertheless must be able to meet and speak, with equal authority and experience, with shipyard officials at the level I have just mentioned.

Question No. 10: Would the shipbuilder prefer the Surveyor in the yard to be an over-worked foreman plater or an under-employed naval architect?

We want the Surveyor to be neither. I suppose the question is really asking whether we want the Surveyor essentially to be of the foreman plater type, probing around to see that steelwork is being properly completed, or of the more theoretical naval architect type, spending his time in the drawing office on plan approvals, etc. The answer clearly is that the ideal Surveyor is a man who has a good basic knowledge of naval architecture, can be helpful on plan approvals but equally is a sound practical shipbuilder with considerable knowledge of outside production techniques and an understanding of the right kind of limits and tolerances to apply when difficulties arise.

Question No. 11: Does the LR Surveyor help or hinder progress in the shipyards?

So much depends on the Surveyor but, without any question, it is clear in my mind and the minds of my colleagues that the Society is normally very helpful in our shipyards, and we regard it very much as part of our team. On the other hand, it can also help us by being tough at times and ensuring that we are not too wet-nursed and do adhere to the standards of construction which reputable owners would expect us to produce.

Question No. 12: Would a publication on shipbuilding practice giving acceptable standards of welding, sequence of welding, fit-up and tolerances, etc., be welcome?

I have touched on this subject before. One's first reaction to this would be 'Yes', but we would have to take great care that this did not introduce a degree of inflexibility that would prevent Surveyors at individual shipyards exercising the correct flexible judgement to meet situations which are bound to arise from time to time and which could not be covered in any publication of this nature. On balance, I think I would be opposed to too rigid a practical construction rule book.

As a possible alternative, a bulletin of current recommended practice might be issued from time to time by Lloyd's Register for circulation to Surveyors and shipbuilders only. If this was updated annually, it could take account of the Society's vast international experience, give details of the best results achieved and indicate to builders where more stringency or more relaxation would be in the best interests of all concerned.

Question No. 13: What additional information on marine intelligence would a builder like the Society to produce?

We find that, when we speak to Principal Surveyors in the districts or call at the headquarters in London, they are always forthcoming in a discreet way about the experience they are gaining from problems arising with ships classed with the Society. It would, nevertheless, be helpful if some sort of regular news-sheet could be circulated to builders giving month-by-month information about structural problems, machinery difficulties, etc., arising on ships at sea, so that we might be able to avoid such pitfalls in our own design and production operations. Certainly Lloyd's Register ingathers all this information and it is ultimately reflected in amendments to the Rules, but there is often a considerable time-lag which might be avoided in certain cases by the circulation of such a technical news-sheet.

Question No. 14: Is the work in producing plans in the yard and approving plans at Lloyd's Register duplicated?

It is not so much that there is duplication in producing plans in the yard and approving them at Lloyd's Register, but rather, I think, the problem in the past has been the duplication of calculations. In this connection, the increasing use of computer techniques will undoubtedly minimise such duplication in the future. I hope it will also be possible to extend the practice, which I have mentioned earlier, of shipyard personnel working alongside the Surveyors in producing basic structural drawings in London. This would not only help our own design draughtsmen to get a better feel of the Society's latest design requirements and thinking, but it would also assist in avoiding unnecessary duplication.

Question No. 15: Would an amalgamation of the major classification societies be of benefit to the shipbuilder?

I have already indicated that I consider this would be a retrogressive step. Competition is a healthy thing in all spheres of activity and there is no doubt, in my opinion, that the classification societies give a better service as a result of the stimulation of competition. However, I repeat again that some co-ordination of activities between societies should be possible and advantageous to all concerned. Certainly in spheres such as material surveying at the steelworks, survey

of suppliers' equipment, etc., I would have thought that there was unnecessary and expensive duplication of effort by Surveyors from a number of different classification societies when only one is really necessary.

It would also be of advantage if some satisfactory formula could be worked out between the classification societies for pooling their very considerable experience obtained from ships in service. I appreciate, however, that, being in competition, this would probably be very difficult to achieve.

Question No. 16: Should the classification societies take over all the work of the national administration such as the Department of Trade and Industry?

My colleagues and I were by no means united on this one. Some had the view that certain fields of work should continue to be undertaken by different administrations so that no one body should become both 'judge and jury'. However, the preponderance of thought amongst my colleagues, and I certainly subscribe to this viewpoint, is that it would be to everybody's advantage if the great majority of the work of the national administration was taken over by the classification societies. I am of the view that we in this country suffer considerably at times from too strict Government interpretation of IMCO recommendations, whereas our competitors are often permitted to build to lower standards as a result of their authorities' more liberal interpretation of these recommendations. Not that I am advocating any lowering of standards below an acceptable safety level. It is a vexed question because, to achieve what I am after, Lloyd's Register would not only have to interpret IMCO recommendations for the U.K. Government, but for other Governments as well. I cannot help feeling that, if this could be achieved, we would not only have the advantage of a common international interpretation of these recommendations but that they would be interpreted with a greater degree of flexibility by the Society rather than in the more rigid and rule book approach of a Government authority.

The well-known quotation that 'the sea does not look at the flag before coming on board' is so very true, and it is surely a nonsense that we cannot in some way find a more common international interpretation of IMCO requirements than at present. In my view the increasing use of classification societies for this purpose could move us much closer to this aim.

I know that at the present moment Lloyd's Register has no say in the affairs of IMCO unless in briefing sessions with the D.T.I. or when it attends, for example, as an adviser to the Liberian delegation. If it was brought into the picture more fully by various Governments to administer the IMCO recommendations, it could and would, no doubt, take a much more active part itself in these IMCO deliberations.

I am conscious, of course, that, if Lloyd's Register were to take on much more work from the marine section of the Department of Trade and Industry, it would probably mean some increase in the fees, since I understand that this particular section of the D.T.I. has been losing quite a bit of money in recent years. Nevertheless, I think the advantages would far outweigh this possible disadvantage.

Question No. 17: Should the classification societies do (a) more consultancy work, and (b) more research work?

I consider that the Society's investigation and consultancy work at the present moment is first-class and very useful. Certainly some extension of this work, bringing in the wide fund of knowledge which Lloyd's Register has from its continuing feed-back of information from ships in service, would be very much welcomed.

On the question of (b) more research work, I would have thought that the Society's present level of research is very satisfactory and whether it can extend it further is something it must itself decide. However, on this question of research, I would like to put in a plea for closer co-operation with the British Ship Research Association. I know that there is a certain amount of cross-fertilisation between Lloyd's Register and the B.S.R.A. at the present time in the fields of structures and computer design techniques but this, in my view, does not go far enough. Unfortunately, whenever we suggest really getting to grips with Lloyd's Register in establishing active and effective research in the structures field, we come up against the Society's argument that they have to preserve their international status. Whilst I apprerciate this, one would have thought a suitable formula could have been found, when so much effort is being made today to break down international barriers, to create a really dynamic structures research effort by harnessing the vast experience and information of Lloyd's Register to the research expertise of B.S.R.A., which is backed by the whole British shipbuilding industry.

Question No. 18: Are the lines of communication between the shipbuilder and the Society direct or quick enough?

The Society is to be congratulated on the way in which it has maintained short lines of communication between the shipbuilder and the Society. Neither my colleagues nor I have any cause for complaint in this connection, and Lloyd's Register offers a good example of how a large organisation can so de-centralise its activities to ensure that quick and effective decisions are given whenever required. It is this speedy commercial approach which commends the Society to me and, in fairness, other classification societies as well, and which makes me feel that it would be to everybody's advantage if they continue to be brought more fully into the administration of all the various regulations affecting the safety of ships and lives at sea.

Question No. 19: How far can a shipbuilder influence the owner in classing with a particular Society?

Over many years we have essentially been associated with Lloyd's Register and Det Norske Veritas. That is not to say that I have not a high regard for the other principal classification societies but, whether it is a question of the devil you know, we normally tend to veer towards Lloyd's Register. There is no doubt that the shipbuilder can greatly influence the owner in his choice of classification society and, without wishing to be specific, my friends at Lloyd's Register know the extent to which ships have been ordered from us to LR classification as a result of our insistence that our offer was based on its requirements. This has been particularly so with a number of foreign owners. To be fair, we have also had nothing but the most satisfactory relationships with Det Norske Veritas, but basically we feel it is to our advantage if we can concentrate the great majority of our newbuildings at Lloyd's Register, since we know its people, appreciate its standards and have worked closely with so many of its Surveyors for a very long time.

A good example of co-operation between Lloyd's Register and Scott Lithgow in recent times is our exercise in India where we have agreed with the Indian Government to assist the Indians in getting their second shipyard off the ground by training their people at Port Glasgow, selling them the design, working drawings, specifications, etc., for our standard Panamax bulk carrier, and providing them with a consultancy service during the construction of their first ship. This bulk carrier, of which we have already delivered two, with three more on order, is classed with Lloyd's Register and automatically the Indians will be building their first ships at Cochin to LR classification. In return for this, we are having considerable co-operation from the Society in providing some of the long-term consultants who are to be based in Cochin.

Question No. 20: Is the shipbuilder satisfied with the feed-back of information from existing ships built by him?

We are getting a fair feed-back of information from the shipowners for whom we build our ships, although unfortunately this tends to be confined to things that go wrong under the terms of our guarantee. I would say, however, that we get most of the information we need from our owner friends to enable us to improve on future ships as a result of this experience from our ships in service.

So far as Lloyd's Register is concerned, we get very little feed-back information on particular ships built by us, unless there are any real problems and then the owner normally gives us this information which, if the problems are structural, we invariably discuss immediately with the Society. The importance of adequate feed-back information on problems arising in all types of ships built by various builders is vital to our future design thinking. In this connection I have already touched on my thought that some form of regular LR news-sheet could be very useful to the shipbuilder. I know that one of the main objections to this idea is that some builders feel their difficulties and mistakes could be identified from this news-sheet by their competitors. Personally, I feel we have now entered a stage of our development where we should not be afraid to let our competitors know if we have certain difficulties. They must equally meet their share of problems from time to time, and the concerted effort of the whole is bound to be more effective than the summation of our individual efforts. I am certainly not afraid to say that we make many mistakes at Scott Lithgow, that our production techniques, our quality control, etc., are not yet what they should be. I think that most of us are prepared to learn from those who have gone the way before. I hope, therefore, that the objections of individual shipowners and shipbuilders, who may be jealously guarding their own particular secrets, will not prevent the dissemination of information and knowledge which would be to the ultimate advantage of the shipping and shipbuilding industries as a whole.

Mr. Atkinson had a twenty-first question—how can the role of Lloyd's Register be improved? But I decided to confine my talk to the appropriate twenty questions, since I think I have really covered Question No. 21 in all the various comments I have made in my twenty answers. If you would like to identify the way in which I think the role of Lloyd's Register can be improved, this would really amount to a summation of my various views and comments in this paper, for what they are worth.

I realise that I might well have touched on various other aspects of the Society's activities—the good work it does in its investigation department, particularly so far as we are concerned in the field of vibrations; possibly I could also have commended it on its work in ocean engineering, where clearly it has a vital and increasing role to play and where we in Scott Lithgow are now very hopeful of entering the field in a fairly substantial way. It is probably interesting to note that the dynamic positioning drillship which we hope to build for the Ben Line will be a repeat of a ship recently constructed in a Dutch Yard to Det Norske Veritas classification. The owners and ourselves wish to build this ship to LR class. It is a very quick delivery and we have been promised the maximum possible co-operation from the Society in ensuring that the change from Det Norske Veritas to LR class will not involve us in any tedious or frustrating delays.

At any rate, I have enjoyed setting down my thoughts about Lloyd's Register in writing. It has been, for me, a useful exercise and I hope that this has been the kind of paper that you wanted and that you are not too disappointed because I have not produced a whole series of graphs, detailed comments on computer techniques, finite stress analysis, etc. These are matters which I now have to leave very much to my more expert colleagues.

Finally, let me emphasise that the one thing I have found in life is that it is easy to be a critic, particularly a destructive one. I hope, therefore, that you will take my comments about the Society in the spirit they are intended and that particularly you will not hesitate in the Discussion, to give me your views about the British shipbuilding industry, with which I am proud to be associated, despite all its many recognised deficiencies. In fact, I think a very good paper for our local Greenock Association of Engineers and Shipbuilders would be an uninhibited view by an LR Surveyor of the British shipbuilder!

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Lloyd's Register Technical Association

Discussion

on

Mr. A. R. Belch's Paper

LLOYD'S REGISTER AND THE SHIPBUILDER

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(Printed without Author's replies)

Mr. B. HILDREW

It is possible to discuss the many facets to each of the answers given by Mr. Belch in response to the questions posed in his paper. In order to limit my contribution to the discussion I propose to refer only to a few of the questions and to comment on specific parts of the answers.

Are classification societies necessary? Recruitment into the Society comes from two broad sources. Recruitment of British nationals and recruitment of nationals of those countries in which the Society operates. In the context of both groups it is becoming increasingly difficult to find men with the requisite education, training and experience and it is obviously essential to ensure the experience of such men is, at least, comparable with those recruited in the past primarily in this country. It is difficult enough to ensure a reasonably uniform interpretation of the Society's requirements with men who are educated in the U.K. and the problem in the context of nationals from other countries is even greater. It is for this reason that the Society has inaugurated the two training establishments which have been referred to by other speakers.

What influence does Lloyd's Register have in the shipyard? The answer to this question proposes periods of overlap or transfer. It is desirable that Surveyors are moved around within the Society and preferable that they all obtain a full spectrum of experience in old and modern shipbuilding procedures and in the ship repairing and marine engineering professions. In consequence, periodic moves are to be expected. If a period of overlap was adopted this would represent in the totality of the Society's wide deployment in field work a commitment to additional staff and in consequence higher fees.

Research into minimum building standards. There is no doubt that shipbuilders build to the Society's requirements and interpret 'minimum' at different levels. Often the Surveyor is pressed to accept an equivalent item manufactured locally and he has great difficulty in justifying a suspicion of its long term unsuitability. For example, the quality of welding obtainable in different yards around the world can range from the excellent to the barely adequate, although the time taken to lay the welds will have been the same. Again, in terms of equipment, certain materials may not have the service life which is anticipated for the hull. Such shortcomings can be difficult to quantify in the as built condition.

Research into new materials. Mr. Belch can be précised as stating 'There is no substitute for steel'. This is true but it is worth contemplating the future of shipping—the only way to carry world trade in any quantity is on the surface of the sea in a ship. The major historical breakthrough which requires inventing is a material lighter, stronger, more easily manipulated and formed and cheaper than steel.

Does the local Surveyor complement or supplement the Quality Control Department? The Author's reply to this question contains the first statement written down by a person external to Lloyd's Register that the basic premise which must be accepted if a large shipyard is going to prosper in the modern world is that the Surveyor provides a quality control on the quality control. This is most effective in Japan where fewer mistakes are made. Those mistakes that are made are identified and rectified earlier in the construction of the ship and thus fewer Surveyors are required to attend on ships which are being built more rapidly than anywhere else in the world.

I note the criticism of the Surveyor who walks off when things are not perfect and advises that he will return when it is in first class order. I would agree with this criticism but equally one must recognise that 'not perfect' in this context does not equate with 'not ready'. When the work is not ready at the time advised other clients who are requiring the Surveyor's service are inconvenienced and can reasonably expect that the organisation responsible should go to the back of the queue.

Does Lloyd's Register set too high standards? Again the Author questions the uniformity of the Society's service. Lloyd's Register does endeavour to apply the same standards internationally as far as possible. However, for many reasons, e.g. availability of materials in a country, the background and training of the Surveyor, the capability of the technology within a country, it is only possible to approximate to a uniform standard, Arising from the need for a uniformity of standard the Society is the only classification society which has established training schools—at Crawley and at Yokohama—utilising a common syllabus with associated course notes. It is largely from the problems of meeting the points raised for instance in Question 4 that these training establishments were introduced.

In Questions 13 and 20 the Author asks for additional information on ship and machinery failures. Both these questions relate to additional information on defects. I am totally in support of this concept and have discussed with the senior technical staff the possibility of circulating such a document. It does require a considerable amount of co-ordination and search into technical records and this has to be seen to be worthwhile to justify the effort. There is also a resistance to disclosure by certain constructors and manufacturers and there could be legal problems as well as loss of goodwill in such a procedure. However, on balance, I would support such a document although many of my colleagues are against it.

Should classification societies take over work from the Department of Trade and Industry? This is a topical question and with the dissolution of Parliament is not perhaps such a burning issue. The amount of work which it was proposed to transfer was relatively small and it does not necessarily follow that an increase in fees will result. The Society's world distribution of Surveyors ensures easier access to any particular job and in any case the Lloyd's Surveyor because perhaps of commitments to other flags tends to do more jobs in a day than the D.T.I. surveyor and thus his cost per job is reduced.

Question 17 proposes a national co-ordination of research. This is highly desirable and could be achieved very rapidiy if the U.K. would adopt and adapt to world techniques. Examples of this would be in quality assurance both in computer-aided design techniques and in the actual shipbuilding procedures.

Finally, in the context of the last sentence of Mr. Belch's paper it is possible that an uninhibited view by a Lloyd's Surveyor of the total British shipbuilding scene as compared with that in other countries might prove unacceptable to many British shipbuilders.

Mr. McCallum

First of all, may I say how pleased we are to welcome Mr. Ross Belch to the platform—I think the first occasion on which a distinguished shipbuilder has spoken to this Association. Of course, Mr. Belch's qualifications for this job are impeccable. Apart from completing his education in a superior establishment, he has been, and still is, Managing Director of an extremely successful shipbuilding organisation during a traumatic period when his competitors and near neighbours were tumbling. I speak with feeling.

But I have no intention of embarking on a eulogy. The Author has no need of that. He has said quite enough in his paper to leave me short enough of time already.

I am delighted to hear that classification societies are necessary and may, indeed, present not quite so many major obstacles as they did in 1864.

Perhaps this is because our Surveyors tend to be more widely travelled nowadays and take a view from a longer perspective. This would not be possible, of course, if they didn't move from one shipyard to another from time to time and I'm sorry, if in our little chess game round the world, we don't always have time to signal our intentions very far in advance. Sometimes I feel that the majority of our staff are waving at each other from aeroplanes, but I'm sure this can't be right.

Just as chemistry and physics are no longer in separate compartments, so the boundaries between naval architecture, marine engineering, aeronautics, structural and civil engineering have become blurred and this has widened to some extent the field of recruitment for Lloyd's Register, particularly in the research and development areas.

Yes, competition is a splendid thing which Mr. Belch knows all about, and perhaps even the chap in 1864 knew about too. It has applied a massive jerk now and again. This time I think we are the ones who are applying the jerk, but it is important, too, that it is the right sort of competition. Scantlings are less, in general, than they used to be. This is not because we are taking bigger risks, but because we know a lot more now about the sea and its reactions on the ship than we did, and the right amount of material can be put in the right place. The other kind of competition is free classification and you can't offer that any more than you can offer free ships.

I should say that a considerable amount of responsibility devolves on the Surveyor on the spot. As far as this Society is concerned he is the man intimately concerned with the problem and therefore probably knows more about it than anyone else. Headquarters do move around too, but there's an awful lot of space to move in. I see I shall have more excuse in future to visit my native land.

Design is the shipowner's and shipbuilder's prerogative, based on the owner's requirements. L.R. are delighted to assist and advise at as early a stage as possible and we try not to take up attitudes to particular design types as, for example, in the particular case of L.N.G. ships, because we know that 'no one type' can be No. 1 for economical construction, for repair, for economical operation and for voyage requirements at one and the same time. The co-operation exercise in London is one of the ways L.R. can help and demonstrates, I hope, the complete freedom of expression to which the designer can give rein.

Production problems are always in our minds and I hope further comments will be made on this, but I draw the line at ten-year obsolescence. It would only give us one Special Survey fee.

It is difficult to lay down building tolerances when we have such a wide variety of building methods to deal with. We have arrived at standards in Japan and Sweden after discussions with the builders, and if the builders co-operate this will come in the U.K. too, to our mutual advantage.

This is a matter, of course, which is closely linked with quality assurance, and I wholeheartedly agree with all the Author has to say on that subject. Too many shipbuilders tend to regard the Lloyd's Surveyor as a foreman checker. I hope that our pilot scheme in Japan will become more widely known and that its successful operation will shortly spread to other areas.

Foreign shipowners have raised, from time to time, the possibility of circulating an advisory bulletin on difficulties arising in ships at sea. and this is being considered. There are security problems, of course, and although un-named, ships are generally readily recognisable, which could result in embarrassment for shipowners—and their permission to disclose would be required. There is, of course, a domestic technical feed-back bulletin which is issued at regular intervals for the information of Surveyors. Shipbuilders are usually well advised of their own failings, particularly within the year of guarantee, but clearly a continuing history would be of advantage. Major problems (such as the buckling of fast cargo ships) have always been the subject of an immediate signal to our Outport Surveyors to convey warnings to the shipbuilders.

The International Association of Classification Societies has had a degree of success in unifying some of the classification requirements, but there are areas where we differ. Of course, we always think Lloyd's Register is right, and with our Technical Committee system we believe that we have a world concensus of opinion to back it up.

As far as the Department of Trade and Industry is concerned, it is common knowledge that negotiations are in progress for the hiving off of certain aspects of tonnage, stability, safety certificates and so on to Lloyd's Register. Many of these aspects of course, we perform for some 80 odd other governments already and, of course, interpret IMCO requirements for them too, according to their intentions. It would certainly be advantageous if Lloyd's Register had a greater (that is, other than advisory) say in IMCO affairs, if only to augment the opinions of the traditional maritime nations.

Again, as far as the British Ship Research Association is concerned, Lloyd's Register is involved in a co-operative effort in an organisation called the Co-Ordinating Committee for Ship Structures Research of which I am a member. Remember the B.S.R.A. is concerned more in aspects of fundamental design than L.R. This Society is probably further ahead in

ship structures research and development than any other organisation and it is clear that the interface between B.S.R.A. and L.R. developments should be clearly defined, and this is what we are trying to do. With good management, they should mate well together.

Finally, let me say that an enjoyable feature of Mr. Belch's paper is that it has been almost entirely constructive. I hope he hasn't been intimidated by being so outnumbered, but at least that's always a change for the Surveyors. Knowing Mr. Belch I'm quite sure he is anything but intimidated!

Mr. F. N. BOYLAN

I would like to add my thanks to Mr. Belch for undertaking to talk to us, about ourselves as shipbuilders see us, and for finding time to do so among his many pressing duties as the Managing Director of Scott Lithgow.

We in the Society are accustomed to being misrepresented whenever we hear, or read of, others describing our functions, and to finding that even people who might reasonably be expected to know better, have only the very vaguest idea of who we are and what we do. Those who have read the ludicrous nonsense in recent articles in various sections of the Press about Lloyd's Register in relation to the work which is likely to be delegated to us by the Department of Trade and Industry will know what I mean.

This is not the case where Mr. Belch is concerned. His paper shows an almost disconcerting knowledge not only of our proper functions but also of our limitations and shortcomings. It is stimulating for us to be in this position and I think that we must take very serious and attentive notice of what he has to say, especially of his criticisms. However, I hope that having faced us at this meeting Mr. Belch does not regret it too much and, in general, I would say that I think he has let Lloyd's Surveyors down lightly.

There is so much in Mr. Belch's paper which invites discussion that one could talk for a considerable time but I am sure that there are many others waiting to say something so I shall refer to only a few points which strike me particularly.

Mr. Belch says that Scott Lithgow always insist in their contracts that Lloyd's Register shall act as the sole arbiters. I was unaware of this and it presents rather a startling picture. I know it has been done occasionally, in Scandinavian countries I think, and I know of one or two examples in Canada. I have always understood that before the Society would accept such an arrangement each case should first be approved by the Committee and that both parties, builders and owners, should agree. Furthermore, the subjects upon which the Society would be prepared to adjudicate must be purely technical. Under no circumstances would financial matters be entered into. I note that Mr. Belch does refer to technical matters and I assume that this condition applies in the Scott Lithgow contracts in the same way.

In these circumstances it is not difficult for the Surveyor to remain impartial because any Surveyor can refer only to the standards indicated by the Rules and when in doubt he must refer to Headquarters. This possibly answers the surprise which Mr. Belch expresses with regard to the Surveyor's attitude in such cases.

With reference to the recruitment and training of Surveyors, this is a problem which becomes ever more acute. It used to be sufficient for new recruits to the Society to have a sound technical background and good practical experience in shipbuilding. The recruit must also have achieved a position of some responsibility in the industry before his application would be considered. The position nowadays tends to be that, because of the very much more sophisticated Rules and the diversification which has developed in recent years, the technical qualifications of recruits must be considerably higher. An Ordinary Degree in naval architecture, or its equivalent, tends to be regarded as the minimum. Many young men enter the Society with a higher standard than this and these tend to become specialists in certain departments, but the normal Surveyor, for two or three years, is moved from one department to another in Headquarters to gain experience and during that period attends courses at the Society's own training establishment at Crawley before joining the field force so, to some extent, Lloyd's Register trains its own Surveyors. The high standard of basic technical preparation is essential of course.

It was rather disturbing to hear Mr. Belch's remarks about Surveyors he has met who have been obstructive and petty-minded 'without the breadth of vision' necessary to carry out their services in the correct manner. It is sincerely hoped that this type, with modern training, is becoming rare, because it is essential that amicable feelings and mutual respect exist between Surveyors and clients.

Mr. Belch says that he feels at times that more responsibility should be given to the local Surveyor to make both practical and technical decisions on the spot rather than to have to refer back to Headquarters. The necessity for an investigation from first principles into the structural design of very large or complicated ships which is usual nowadays tends to curtail the freedom of the man in the field because he does not have access to the many complicated computer-based calculations in Head Office. The same applies to a great extent even to structural details because these become vitally important in heavily stressed structures and in the interests of good workmanship design of quite small components must become fairly standardised. However, the experienced Surveyor will, I am sure, always be able to assist in many ways in problems which arise during construction.

With regard to the 'economics of shipbuilding', I find Mr. Belch's comments somewhat contradictory. He says that in this day and age with the cost of a man hour increasing at such a rate, design for the most efficient production is all important (this must also be true for the cost of steel) yet he continues 'for far too long there has been a fetish for minimum scantlings'. I would have thought that from the point of view of efficiency the Society must always attempt to indicate minimum scantlings, which must inevitably imply also the most efficient distribution of material, and that it is for each builder, rather than Lloyd's Register, to develop details and structural arrangements to suit the particular procedures and practices of his own yard and equipment.

I was very interested to read in this context that Scott Lithgow have added 1000 tons of steel above minimum scantlings into their standard 250 000-dwt tanker in order to achieve ease of production. I was under the impression that overlapping joints had been tried and found wanting and that the 'cleanest' structure was one in which the prefabricated sections fitted exactly and closely and provided good welded connections. It is a common practice nowadays for a series of ships to be built to each new design and this tends to justify a full system of preparation and arrangement of prefabricated sections, etc., to be developed for each new contract then,

given a good standard of control, there should not be great difficulties.

With reference to 'building for obsolescence', Mr. Belch suggests, jocosely, that we should combine with builders in planning for total obsolescence in tankers after ten years in order to provide fat new contracts at more frequent intervals. Some years ago there was actually a serious proposal that tankers *should* be built for a ten-year life within the cargo tank lengths, the forward and after ends of the ship from the cofferdams outwards being built of more robust structure. The idea was that after ten years the cargo tanks should be cut out, scrapped, and the machinery and forward parts of the ship joined to a new cargo tank length and a special notation made in the Register Book. After much thought and discussion this project was abandoned. Mr. Belch was joking but corrosion is a very real problem. With modern methods of calculating and analysing structure, it is possible to produce a huge ship with the scantlings and materials barely to meet the stresses to which it will be subjected in service (minimum scantlings). But if this should be done perfectly then, of course, in theory at least, the entire cargo tank spaces should be renewed after one voyage. However, we are now faced with the problem of what corrosion margins should be allowed on approved plans. Several big tanker owners are co-operating with Lloyd's Register in monitoring the rates of corrosion in cargo tanks and it is possible that at some future date approved plans will show the minimum Rule thickness with the corrosion allowance (which will vary for different items and for types of protection systems) shown separately for each piece of structure.

With regard to quality control, nowadays with the vast sizes of modern ships, the Lloyd's Surveyor cannot be directly responsible for the actual standards of workmanship in any yard, he cannot hope to see every inch of weld preparation or weld for instance. For this reason I was very pleased to read Mr. Belch's comments to question 6. He says there is no question in his mind that Lloyd's Surveyors should complement the builders own quality control department *which should be totally complete and sufficient in itself* and that the Surveyor's essential function is to check that the quality achieved by the shipyard's own quality control meets the required standards.

I do not think the problem could be expressed more clearly than this. It is to be regretted that this truth is not recognised so fully in many other yards.

Mr McCallum has drawn attention to the arrangements for quality control being made in Japan, which we hope to propagate throughout the Society in time, so I need not go any further

Finally, the paper and discussion, being presented here, tend naturally to reflect the position as it is in Britain. But at least 80 per cent of the Society's Technical Staff are serving outside the United Kingdom at any one time. The majority of these countries present their own problems, of climate, traditions, state of industrial development, etc. Therefore, the difficulties of staff recruitment and training and the maintenance of uniform standards throughout the world are considerable. However, I assure Mr. Belch that every effort is made to achieve those ends; by the careful choice of Surveyors who are put in charge, by distribution of standard circulars and instructions, by bringing men from all over the world to our training courses at Crawley or to those set up in Japan and we sincerely hope that there are very few cases of 'one law for the rich and one for the poor' which he has suggested. It must also be acknowledged, of course, that in many countries the standards of workmanship are already of the highest and would bear comparison with any other.

There are so many other things which could be said on Mr. Belch's excellent paper, but I intend to stop to allow colleagues time to express their views. I wish simply to renew my thanks to Mr. Belch.

Mr. S. N. CLAYTON

As I was not aware until this evening that this was the first of a series of papers and having read the title in the broad sense, I approached Mr. Belch's paper fully anticipating finding myself for at least part of the time in the engine room during installation. I found that I was well into the paper before the word 'machine' arrived and that referred to a shipbuilding term and in reading further the only direct reference to engineering came where the words 'machinery difficulties' appeared. My spirits rose when I realised that this reference was in the context of feed-back information only. Whilst appreciating Mr. Belch's point that the passing of information concerning problems to competitors should present no difficulties, I am by no means sure that all engine-builders or gear makers, for instance, would be willing to see their problems publicised. That said, I endorse his view, given certain guide lines and conditions, that information regarding recurring problems should be disseminated. It is also relevant to point out that the computer at Headquarters is being continually fed with valuable information regarding defects and failures which either through Rule amendments, or other means, should be made available to designers.

Having spent some years abroad I found myself speculating on the replies which builders in other countries might have given to the same questions. I feel sure they would endorse many of Mr. Belch's answers with a fervent 'hear-hear', but many would be less disposed to be so hearty over the question regarding our quick lines of communication. I know that many of these builders also feel that classification societies are ready to skim the cream of their shipbuilding talent although I must add that there is less migration from the shipyard machinery side to the Society than is the case with the naval architect.

Many builders abroad, particularly in the major shipbuilding countries, would almost certaintly disagree with the remarks made regarding quality standards. They too take every opportunity to visit foreign-built ships and feel that they are being forced to adopt high standards and that the competing countries enjoy more leniency.

As regards consultancy and research and, in particular, the Society's proposed connection with the British Ship Research Association, there is no doubt that this can be of benefit to shipbuilder and owner alike but one must remember that shipbuilders in other countries also have agreements and liaison with their own national research bodies. This does not ease the problem of breaking down the international barriers mentioned in the paper. Nevertheless, many of these builders do approach the Society for its views which is an indication of the regard in which the Society is held.

When the subsequent papers are presented covering our relations with others in the marine field, I am sure that we are going to find that many of Mr. Belch's comments will be reiterated.

Thank you for a most interesting paper.

Mr. J. B. DAVIES

Some while ago Mr. Belch and I were at the Lithgows Club *Burns* Supper and if an expatriate Englishman may be allowed to quote *Burns* may I say,

'O wad some power the giftie gie us
To see oursels as ithers see us!'

The view of the Society as presented by Mr. Belch is really rather flattering and, I think, reflects great credit on our predecessors in the Greenock office who have built a good relationship with the shipbuilders. It also says a great deal about the staff in the various yards in the Scott Lithgow group for without their collaboration such a relationship could not have been formed or be maintained.

There is much in this paper on which I could comment but as many others want to take part in tonight's discussion I will be as brief as possible.

Under Question 2 Mr. Belch makes a plea for more local decisions and less reference to Head Office—incidentally may I say that while I can guess the origin of many of Mr. Belch's points I will need to make some enquiries regarding this one when we get back to Greenock—and I certainly agree with him that as many decisions as possible should be made locally.

However, he has partially answered his own point under Question 4(d) when he talks about different standards in different countries. The only way to obtain complete uniformity is to refer everything to one office—and, ideally, to one individual—and one simply has to try and adopt a reasonable compromise.

Speaking as a Surveyor whose 28 years of service are approximately equally divided between Head Office and outports I must say that I realise what an extremely difficult problem this is. Perhaps I could take this opportunity to make a plea for a greater circulation of London Office decisions, I am sure our colleagues in, say, Holland raise points which would interest us in Scotland and I would hope that some of the queries we feel worthy of referring to London would also affect other countries.

Under Question 4(b) I was delighted to see Mr. Belch refer to the 'fetish of minimum scantlings' as, for a long time, I have felt that many builders give themselves extra work by endeavouring to adopt the Rule minimum scantlings for every individual item. Such designing inevitably leads to the 'bitsy' structure the Author mentions and it will be extremely interesting to see if the saving in man hours outweighs the cost of the extra material. I sincerely hope so!

Mr. Belch mentions quality assurance and several previous speakers have taken up this point. I quite agree that one must never allow the control system to so dominate proceedings that it becomes more important to move pieces of paper round offices than steel sections around the yard but equally I am convinced that a good quality control system in the fabrication shop will save hours on the berth. I know that Lithgows are searching for this happy mean.

If, Mr. Belch, I had to do any press-ganging to persuade you to write this paper may I say now that I have absolutely no regrets, for if I had been easily put off the Association's Transactions would be without a most interesting and valuable paper.

Mr. L. BECKWITH

In this paper, the first of a new Technical Association series, Mr. Belch has set a standard which, if followed by future authors, will make the series very worthwhile.

The questions asked and the answers given in the paper, cover a very wide range, indeed a paper could probably be written about each one, therefore, I propose only to consider Question 16 . . . 'Should classification societies take over all the work of the national administrations such as the Department of Trade and Industry'.

The answer that Mr. Belch has given, is based mainly on the interpretation of regulations, but it must be remembered that there is much more to the work of a maritime administration than the application of rules. i.e.

Writing national regulations.

Laying down acceptable standards.

Approving items of equipment.

Manning national delegations at international meetings.

Organising national working groups of interested parties to discuss international proposals.

Investigation casualties.

From this it will clearly be seen that it would not be possible for the classification societies to take over these tasks and, in fact, it would be improper for them to attempt to do so. However, I have a great deal of sympathy with Mr. Belch's problem regarding the many and varied national interpretations of IMCO regulations. There is no doubt that they create difficulties for shipbuilders, owners and indeed, classification societies, but in many cases, they are brought about by the loose drafting of regulations which deliberately leave interpretation to 'the satisfaction of the administration'. These words have unfortunately found their way into many sets of regulations either because complete agreement could not be reached, or because time did not permit full discussion which would have produced a more explicit regulation.

One example of this can be found in Regulation 25 of the 1966 Load Line Convention. The regulation states 'satisfactory means (in the form of guard rails, lifelines, gangways or underdeck passages, etc.), shall be provided for the protection of the crew . . .'. The result of this vague wording is that there is a range of national requirements, varying in tankers from a single lifeline fore and aft, to a full gangway above the deck, plus shelters on the gangway.

Another example of poor drafting was Regulation 27 of the same convention. It did not take long to realise that the regulation could be interpreted in a number of ways and in order to speed up the process of obtaining a uniform interpretation, the classification societies set up a load line working party. The resulting recommendation was accepted by IMCO and applied by all those countries which signed the 1966 L.L.C. The working party continued looking at anomalies of the Convention and to date has produced some 35 unified interpretations many of which have been internationally adopted. The working party eventually became one of a number of working parties of the International Association of Classification Societies and is now considering stability as well as load line.

As IACS has consultative status with IMCO, I believe that it is through the various IMCO sub-committees, that the classification societies are better able to influence the drafting of new regulations.

The question of delegation of authority to the classification societies to undertake statutory surveys on behalf of the national administrations is another matter. The societies already assign load lines on behalf of the majority of

administrations and some societies issue other statutory certificates on behalf of countries unable to do so themselves. Lloyd's Register in particular with its world-wide representation, is well equipped to undertake such work. If more delegation of authority were to be extended to the classification societies questions of interpretation could more easily be brought to the attention of the governments concerned. However, it should be remembered that in the case of such delegation, final responsibility must always remain with the administration.

We have on many occasions been surprised to find builders, particularly those in the U.K., totally unaware of national regulations or their interpretation. Whilst we are quite happy to assist in providing such information, I feel that builders may be spared embarrassment if a better communications system existed between them and their representatives on briefing groups and national delegations. Perhaps Mr. Belch would care to expand on this point.

Mr. Boylan has mentioned that builders also appear to be unaware of the scope of Lloyd's Register's activities in the field of international conventions. This is a subject which could be talked about for a considerable length of time, but I can say that the Society's next Annual Report will contain a chart which will illustrate this.

Mr. W. H. MARSDEN

I would like to state that Mr. Belch's paper is certainly appreciated and very welcomed in ensuring that the service we as a Society provide for a builder is still the service which the changing industry requires. This paper certainly gives us some answers in this respect.

Referring to the Author's reply to Question 2 concerning the important link in the builder's line of communication with classification headquarters, it is apparent, this is of extreme importance in the case when a shipyard decides to make the capital cost involvement in the production of very large tankers. It has been the practice for a number of years to encourage builders, accompanied by the Society's local staff, to visit Headquarters to discuss structural design before deciding on plans of scantlings. This arrangement for tanker design has been used in Belgium, Denmark, Germany, Holland, Spain and Sweden also to a lesser degree in France, Greece, Italy, Portugal and Yugoslavia. The practice of involving the local Surveyor in Headquarters meetings enables local decisions on scantlings and arrangements to be taken more readily. I would welcome Mr. Belch's views on whether he considers it an advantage for a representative of the local office to accompany his technical staff when discussing work at Headquarters.

Mr. K. J. FRYER

Our thanks are due to the Author and his colleagues for producing such a thought provoking paper, which being of a more general nature, is all the more welcome.

It may be of interest to note that in recent years, a well known Japanese shipbuilder, having produced a standard ship design, the cost of the ship being of the order of £1 million stated that this figure was linked to classification by a competitor of ours. If classification by the Society was required, then there would be an extra charge. It was understood that approximately the same amount of material was required by both societies. One could assume from this statement that the Society was more stringent in its survey requirements than the other, and would therefore produce a better ship, but from a 'business' point of view, the Society would be the loser.

It was interesting to note the Author's remarks regarding the use of extra steel to facilitate production and reduce overall costs. The extra steel used on a $\frac{1}{4}$ million-ton tanker represents about 4 per cent of the total steel weight involved, assuming some higher tensile steel is used.

The same problems regarding painting apply the world over. These are partially solved by some builders who use a paint shop large enough to take a prefabricated section of any size, but of course, there are always areas in way of ship welds and any damaged parts, not to mention the deck and side shell painting to be done in the open. It would appear, however, that there is still a very sound case for under cover building for large ships and indeed, it may be essential in the future in order to preserve the dwindling labour force available.

Mr. D. J. NICHOLAS

While waiting impatiently for my train this morning I found mystelf looking at a poster showing a man with his feet up, happily smoking a pipe. Underneath ran the following extract from a dictionary: 'CONTENTMENT n. — *the fact, condition or quality of being contented; pleasure; gratification*'. It went on to say that this was the feeling common to everyone who had reserved advertising space in a certain Sunday newspaper.

I am sure Mr. Belch must have had the same feeling when he came to the end of these 20 questions. I too had that feeling when I read the paper, for here was a leading shipbuilder saying that subject to a few minor amendments he was generally pleased with the service which Lloyd's Register provided.

It wasn't until the second reading, however, that I noticed Mr. Belch's remark, when discussing the shipbuilders influence on the choice of class, '. . . but, whether it is a case of the devil you know, we normally tend to veer towards Lloyd's'. Well, if that really is the highest commendation he can give us, I suggest we should pack up, cash in the pension fund and retire to the sun!

As it is perhaps unlikely that the General Committee would endorse this action we must ensure that the type and extent of the service which Lloyd's Register can offer is so superior to its rivals, that Mr. Belch and his fellow shipbuilders throughout the world would, given a free choice, specify that all their ships be built to the Society's class.

To achieve this we must constantly seek to improve and expand our service to meet the changing requirements of our potential clients. In the last few years the Society has formalised its approach to ocean engineering and now the department responsible for it is going from strength to strength. More recently a Specification Services Department has been set up largely to assist and act on behalf of owners and as a consequence we are being asked to advise not only on technical matters but also on shipbuilding contracts and purchases, areas virtually uncharted by the Society. In these ways we are already adapting to new requirements and I had hoped that Mr. Belch might have been able to make some equally radical proposals about our role in the shipyards, although I realise that if we adopted all his suggestions the overall effect would be significant.

By limiting his criticism of the Society Mr. Belch makes me hesitant about criticising British shipbuilding, but as he

has openly invited it in his paper I hope he will forgive me if I fire a few broadsides into what is now a rather familiar 'Aunt Sally'.

The first and most obvious criticism must surely be the industry's lack of expansion. In 1963 the U.K. launched just under one million gross tons out of a world total of 8·5 million tons. In 1968 while the U.K. produced much the same tonnage the world total increased to 17 million. Preliminary figures for 1973 show the U.K. just topping the million ton mark while the world total shot up to 31 million tons. Even granting that gross tonnage is a clumsy yardstick, I cannot see how it can be shown that the U.K. has seized the opportunities available to it, particularly with regard to the healthy U.K. merchant fleet.

This leads me to my second point, namely, recruitment and training, for I feel the present state of U.K. shipbuilding is in no small measure due to its failure to project itself as a thriving, go-ahead industry appealing to a range of people other than those born within the sound of the shipyard hooter. In my opinion too little attention has been paid to attracting the brighter school-leavers into the industry and to teaching those that do join, the management skills so necessary once they have gained their basic academic qualifications.

This middle management malaise, as I would term it, must surely contribute to the slowness with which British yards adopt new procedures and operational methods. Where is the impetus to come from to build new yards to compete with the second generation Japanese yards now being developed from the immediate post war ones? Without a lively and forceful management, too much time has to be spent warding off daily crises, leaving too little time for long-term planning or examination of present systems.

I am sure, Mr. Belch will be impatient to reply to these familiar criticisms. Whatever shortcomings British yards may have we must all certainly share his pleasure that they currently have well filled order books and let us hope his confidence in the future will materialise.

I thank the Author very much for giving us his views on Lloyd's Register, allowing us the opportunity to add some of ours and air some of our feelings about British shipbuilding.

Mr. J. R. G. SMITH

This is a very illuminating paper and I am very grateful to Mr. Belch for the time and energy he has spent in producing it. I would like, if I may, to highlight four observations made by Mr. Belch in his answers to the questions posed by Mr. Atkinson.

Question 2: When a Surveyor leaves a particular yard, Mr. Belch wishes that a knowledge of personnel and construction methods be passed to the succeeding Surveyor.

Question 4(d): Mr. Belch does not wish Lloyd's Register to state clearly in writing our minimum building standards for welding gaps, undercutting, fairing, etc. Nevertheless, he would like to see a more uniform approach to the problem of minimum building standards.

Question 6: Mr. Belch states that the Surveyor's essential function is to check that the quality achieved by the shipyard's own quality control meets the required standards.

Question 12: Mr. Belch makes several observations about the suggested 'book of acceptance standards'.

There is a clear relationship between these four points and I would suggest a solution embracing them all: —

If a shipyard has aspirations towards a quality control system, it follows that the yard must have established its own minimum building standards and remedial procedures. These standards will presumably be generally acceptable to the Society's Surveyor in the yard or he would have made it known otherwise. Also, these standards will presumably be clearly stated in writing for the use of yard personnel. If not, I would strongly recommend that they are. A book of general building standards and construction methods, together with remedial procedures, prepared by the builder, in conjunction with the Surveyors involved would thus form the desired continuity between successive Surveyors.

Such a book would (and in my opinion should) be a permanent fixture in the L.R. office at each shipyard, together with Surveyor's notes and comments. The succeeding Surveyor, or the relieving Surveyor, would then have a ready source of information as to yard standards and methods and the continuity and uniformity of approach sought by Mr. Belch would be achieved.

Further, I would suggest that having got that far on an individual yard basis, the yards should then get together, in conjunction with the Society's Surveyors involved, with a view to applying a uniform level of minimum building standards and remedial procedures. A full quality control system could perhaps be built on that base.

May I thank Mr. Belch once again for his paper and the opportunity it provides for fruitful and stimulating discussion.

WRITTEN CONTRIBUTIONS

Mr. R. G. LOCKHART

With regard to Questions 3, 14, 16 and 17 I would like to comment as follows: —

As head of the Society's Hull Design Appraisal and Plan Approval Department it has always been my belief that if all we could offer to builders was minimum scantlings as an inducement to class we would fail miserably. We are now at the stage (considering V.L.C.C.'s for example) when before looking at the midship section and embarking on time consuming finite element calculations we can spend useful time with the builder or the owner examining the complete tank arrangements. For example, is the spacing of the longitudinal bulkheads optimum? Does the spacing of wing tank transfer bulkheads offer the best solution for IMCO outflow? Is the spacing of these bulkheads and the transverses ideal for shipyard erection? One could go on all night asking such questions, the answer to each of which can affect the economics of the shipyards.

We have dealt with the Scott Lithgow group in such thinking. This pre-basic design concept is a service which is being utilized by builders and owners throughout the world. We are also in a position at this stage to up-date our knowledge from service experience. I believe our knowledge is there for sharing.

I would like Mr. Belch to comment on this philosophy and whether he would wish to see such a service continued or expanded.

Mr. P. MANSON

I would like first to congratulate the Technical Association Committee in taking steps to invite people outside the Society

to present a paper on their experience good or bad, in their dealings with the Society, on matters relating to classification requirements and Surveyor participation in the shipbuilding and marine engineering industries. I feel this step is in the right direction, and the Society as a whole should benefit from exercises of this kind. I sincerely hope that this will not be confined to the U.K. and European zone of operations, and that our far-off overseas friends will be invited to present papers of a similar kind.

Mr. Belch, in presenting his paper, has dealt with each question in a fair and reasonable manner and with great diplomacy for such a difficult subject.

He has, in answer to the first question, drawn a comparison between the rule of thumb approach to design held in 1864 and even up to the 1930–45 period of this century and the present approach with which we cannot function without the use of the computer. However, in the shipyards, repair yards and manufacturing industries, the Surveyor has still to make on the spot decisions, and in this respect I agree with Mr. Belch's remarks regarding the future intake of Surveyors, who should have the basic background of practical experience. I know of yards where the practice was to detail their young graduate employees to accompany the Surveyor on surveys and by this means they gained valuable experience. The employee also acted as liaison between the Surveyor and shipyard foremen and management, progress reporting, and informing the Surveyors on their daily visits to the yard on the progress of work and if any tests were ready. In other words he was a very useful contact man. This arrangement in my opinion would benefit the shipyard in the first instance in their training of future management, and should the graduate after gaining the necessary overall experience decide he would like to join Lloyd's Register as a Surveyor, then he would be a very useful addition to the staff of L.R. although, in my experience, this transfer did not happen very often.

On the comment regarding amalgamation with the British Corporation, I would suggest that events since have proved that had this not taken place, one or the other society would have suffered. On the other hand competition, I would suggest, is stronger today that it has ever been, especially overseas, and a combined effort is most desirable. I fully agree that in this era, classification societies should be able to find a satisfactory formula for closer co-operation in certain basic fundamentals of ship design and construction.

The mainstay of any classification society in this highly competitive world, is as previously indicated, the service our field Surveyor gives to the shipbuilder and clients, with the necessary backing from H.Q.

With the sophisticated approach to ship design today employing analysis by computerised finite element methods. I would suggest that basically there is little choice between one classification society and another and that is why our field Surveyor is so important to the Society's well-being. Mr. Belch has demonstrated this point in his remarks on the economics of shipbuilding, in his answer to Question 4.

On the question of ship obsolescence, could not classification societies get together on this vexed question? How often we hear of shipowners who run very old and badly maintained ships, taking their ships out of Class and going to another society where they hope they will be accommodated. Maybe this should be a joint effort with underwriters and classification societies.

With regard to research into minimum building standards and with all due respect to Mr. Belch's remarks regarding the standards of inspection of foreign manufactured equipment, this sort of statement can be heard no matter on which side of the world a ship is built. From my experience a ship which is dry-docked in another part of the world for say guarantee docking, comes under very critical eyes all round, and I would suggest we all have our embarrassing moments at the times of guarantee docking, some perhaps more than others. In this respect I personally feel there is not enough opportunity for management at shop floor level to visit other countries to see how things are done, and from my experience an opportunity is always open for discussions on such occasions, on procedures at a particular yard, or yards. Most concerns have a much broader outlook, and are not so secretive as was the case in past years.

On Question 5, I am interested in Mr. Belch's remarks regarding the Society's specification service. I would be interested to know if Mr. Belch has a preference for L.R. services as against an owner's own representative being at the yard. This may be an embarrassing question and therefore I will fully understand should he decline to answer. From personal experience with ships built for the Russians, I feel they had a good arrangement whereby an acceptance committee is formed from the ranks of responsible members of the crew who are headed by the owner's chief representative. If a delicate problem could not be resolved between the yard and owner's representative, then the Lloyd's Surveyor was usually called in to give his opinion, which was in nine cases out of ten, accepted. This system was in operation over a decade ago, and whether it is still applied today I cannot say. It did, however, result in work progressing smoothly.

We hear so much these days about quality control (Question 6). I feel the quality of material is generally satisfactory, but control is lacking, particularly in the field of cleanliness of layout in shipyards and engineering works. This condition generally continues to the ship during outfitting, even today when everybody should know in particular, the standard of cleanliness required for steam pipe systems, lubricating oil and control systems, we still frequently hear of troubles associated with dirty systems. I would suggest control for cleanliness is sadly lacking. There seems to be no person responsible for this aspect.

Mr. Belch again raises another important question on standards, especially of items delivered from abroad. This is a very difficult question and I am sure most of us will agree that perhaps we, as a Society, may aim a little too high, but in the end I feel it can work out to the benefit of the shipyard as well as the owner. From my experience I would suggest we in L.R. tend to demand higher standards from overseas yards than is applied to the U.K. Industry. I think in fairness, however, we can all throw stones at one another and blame the standards of foreign equipment as being less than ours. To be quite frank, however, and I am very sorry to have to say this, but my own experience indicates the reverse to apply.

On Question 11, this brings our minds back to Question 7, where basically the aim is high standards, and being tough at times as Mr. Belch has pointed out. Most important of all aspects is good sound common sense, which today in view of the complicated systems which have been developed would appear to be lacking in many spheres of activity.

In terms of marine intelligence the British shipbuilder is his own enemy. The yards work quite independently, and treat each other as competitors in the true sense of the word. If my assumption is wrong then perhaps Mr. Belch will say so. From my experience abroad I know that in a certain country

the technical departments of different competing shipyards get together by meeting approximately every two to three months at which time discussions are held on various problems that have occurred during the previous period and if resolved or not an exchange of views takes place. This may be related to an alignment or vibration problem, or even an unexplained rise in stern bush temperatures in a twin or triple screw container ship. There are unexpected problems that can arise over a two or three months' period, and these can in many cases be quickly resolved by being discussed at these meetings. The meetings are held in turn mainly at the principal yards. I feel we in the U.K. are very insular, so long as we do alright it's bad luck for the next chap. This would appear today to be our national character. As previously mentioned this arrangement may well already be in existence, and I would be glad of Mr. Belch's views on the matter.

On Question 20, the points raised have been partly covered already in my response to Question 13. On the point of feedback on particular ships built by a yard, politically this may be difficult as Mr. Belch will appreciate particularly over the first 12 months of the life of the ship (guarantee period). I would suggest this should come from the shipowner rather than the classification society. The shipowner I feel does not keep in touch with classification societies as much as he might do on matters of running problems except of course when a major fault occurs then the shipbuilder and classification society get to hear almost simultaneously of the difficulties. However, I know of certain shipbuilders who have technical staff stationed at strategic points who can fly at a moment's notice to a ship in trouble even after it has run out of the guarantee period, and of course the shipowner knowing this service is available, will keep contact with the ship and enginebuilder, and by this means the shipbuilder and enginebuilder obtains valuable information, which can be applied where necessary to future design.

In conclusion, from my own personal observations in this country, and again I may be wrong, it would appear that there is not enough joint research work carried out between shipbuilding companies, related manufacturing companies, shipowners, universities, and research organisations, such as the British Ship Research Association and National Physical Laboratory and others, and of course, including the extensive knowledge of Lloyd's Register in the field of various investigations carried out by the Research and Technical Advisory Services Department. Some would appear in some aspects to be going their own way resulting in duplication of effort, whereas overseas, consultation between the different establishments appears to be more prevalent, this is done through a co-ordination committe, consisting of government and private organisations. Again, as a mere observer, I would be glad of Mr. Belch's comments on our shipbuilding industry research organisation. Is co-ordination adequate?

Mr. T. NELL

It is most interesting that the Author consulted with his colleagues in presenting his opinions so that there is a concensus from one yard, although it is noted the Author states that he does not always agree with the opinions of his colleagues. It is refreshing that the Author has asked for criticism of builders—I think all Surveyors, by virtue of training and experience, are critical and it is my hope that we are always constructive.

From his service in various shipyards throughout the world the Surveyor sees many systems in use and one of my criticisms of the British shipbuilder is that he makes little effort to 'pick the brains' of the Surveyor. Suggestions frequently put forward are killed by the expression 'yard practice', and in time the Surveyor can become disheartened. The difficulty the Surveyor has to avoid is publicly making comparison with another yard. However, as many of us know when we make complaints, we are informed that something is 'good compared to ....'. When the Surveyor finds something seriously wrong the first question most frequently asked by management is 'Whose fault is it?' e.g. yard or drawing office. Seldom is the first question 'How do we rectify it?'

I would agree with the Author's comments regarding the fetish of minimum scantlings, but I think the Society's policy is correct in publishing Rules to show minimum scantlings as it is not possible to cover the many types of ship in one set of Rules. This system permits individual builders and owners to cover local increases. However, with minimum scantlings (which may require later rectification work) I feel that shipbuilders do not make a full cost analysis. As an example, deckhouse tops may have induced buckling due to welding of beams and subsequent working. If the decks have to be subsequently faired by fitting girders, or local flats or by heating, this becomes an expensive labour item. It was my experience when abroad, where expensive labour charges prevailed, the builders preferred to fit heavier plating to combat labour charges. Yet in this country, where cost of labour is now becoming high, builders still fit minimum thickness deckhouse tops, and must spend huge sums and a vast amount of time by 'Tampo' heating or similar rectification.

The practice of fitting various small lugs and brackets involving little steel but lots of labour can frequently be eliminated by better design.

I must disagree with the Author on his advocacy of overlaps rather than butt-welding. In my opinion, this arrangement, because of the need for less 'watch-making' accuracy, encourages poor work and also frequently introduces an extra thickness which creates the problem of misalignment. Unfortunately, misalignment is one of the major causes of defects in service but does not appear to receive adequate attention in the shipyard.

It is my experience that with overlaps there is a tendency to secure fabricated panels in place without reference to fairness, e.g. shell panels in engine room, incorrectly rolled and/or set, which would be faired by the profusion of minor tank bulkheads, can be very unfair if the tank bulkhead seams are overlapped.

I would differ with the Author regarding the influence of the Surveyor in the shipyard. To talk of the Surveyor as a team man, to me, is a wrong precept and most of the Author's comments relate to this misconception. It must always be remembered that the Surveyor is independent. We all hope to get on with people but occasions do arise when the Surveyor may not be popular in the yard. However, by making some decision which makes him popular in the yard, he may well become very unpopular with the shipowners or even the Society. By the same reasoning the converse situation could arise.

'Obstructive and petty-minded'—most Surveyors, I am sure, try to carry out their duties fairly but this expression implies he is obstructive because he does not fall in with the wishes of the yard management. Co-operation is a two-sided operation and does not mean agreement with the yard under all circumstances.

The fact that the transfer of a Surveyor breaks up a shipbuilding team verifies my earlier comment regarding the Surveyor's essential independence and furthers the concept that the Surveyor can become part of management. Usually, on transfer, there is an overlapping period but its purpose is to establish the position of the ship production at the time of transfer in order to achieve the end product—a ship to be classed with the Society. I note that the Author states that in consequence of the transfer the shipbuilders have to start all over again. I would put the emphasis the other way—the Surveyor on transfer is under great pressure. Besides change in yard, personnel, types of ship and possibly construction standards he is trying to cope with changing town, may be country, changing house and personal and domestic problems.

The Author touches very generally on quality control. In my experience this is one of the most erratic sections of British shipbuilding, varying from good to indifferent or even non-existent. I never cease to be amazed that a shipyard which has spent valuable money installing sophisticated machines for preparing plate edges, or for automatic welding, in the fabrication shed, spends little or no money on adequate checking facilities and permits such work to be destroyed, i.e. edges hand-burned, or machine welds burned back on the berth at the behest of some foreman without reference to top management.

Whilst the shipbuilder may never achieve 100 per cent perfection it is my contention that the Surveyor should be working for the highest attainable standard. He can then adapt to an acceptable standard drawing from his experience, provided the highest standard is always the ultimate aim.

In regard to workmanship I often wish the British shipbuilder would appreciate that, even now, his ship is still a window on the world for the foreigner. Whilst the Surveyor abroad also strives to maintain a high standard it is most disconcerting for the British Surveyor when the foreigner comes along to compare some British ship in the harbour which has some peculiar detail or indifferent work, especially if it is related to an item which the Surveyor at the port will not approve. On similar lines I remember a ship built in the U.K. for a foreign owner. Shell and deck transverses in the engine room were out of alignment and the necessary rectification work was completed satisfactorily. However, the acid comment of the owner's representative was 'We came to Britain to get a good ship—we could have built one like this at home'.

Under the answer (d) to question 4 the proposal to publish a minimum standard of workmanship would, I believe, make the Surveyor's life unbearable. This standard would soon become known as the acceptable standard, to the detriment of all concerned. Just as builders now generally work to minimum scantlings so the work force would soon become conditioned to working to the minimum standard and the Surveyor would be in no position to seek improvement.

The Author states he does not like the occasional Surveyor who may walk off the survey because things are 'not perfect'. I would assume the word 'perfect' has been misused here, whilst if correct, I would suggest, as perfection is so rarely found, many yards would have no surveys carried out at all. I am sure no Surveyor walks off a survey without good reason. His programme will have been arranged to suit that survey and its postponement by him could increase his workload at a later date. If the Surveyor does walk off, I think he must provide the manager with adequate reasons.

Another criticism of the British builder, in my experience, is the lack of co-ordination and responsibility between department managers, particularly between fabrication shed and berth. Regularly, to pacify the god 'tonnage worked', incomplete sections may be forwarded from the shed to the berth. The personnel at the berth do all the necessary work on the 'join-up' but ignore other deficiencies. At the offical survey when the Surveyor points out defects the invariable answer is 'That is shed work' and the berth manager promptly ignores it. Similar remarks apply to sub-contracted items, e.g. W.T. doors. Whilst these have usually been surveyed at the contractors' works, they may have been transported many miles with much handling and even been dropped before eventual welding at ship. When the Surveyor attends for the hose-test there has usually been no preliminary test and if leaks show up the usual answer is 'Contractor's item', and again yard personnel do not seem to want to be involved. It will be seen that the Surveyor is left to chase up management. When incidents like these occur several times, the Surveyor may have good reason to walk off the job. Sometimes it is the only way to get action from management.

Naturally, I would hope that none of my remarks apply to Scott Lithgow, but I would assure the Author that the Surveyors do try to co-operate with the shipbuilder, it certainly makes life easier, but they must also be able to satisfy the Committee of Lloyd's Register that the ship can be recommended for class.

In conclusion, after this long-winded contribution I would thank the Author for his interesting presentation and hope that my colleagues will take up other points in the paper.

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Lloyd's Register Technical Association

THE INTERNATIONAL CONFERENCE ON MARINE POLLUTION, 1973,

and resulting

INTERNATIONAL CONVENTION

R. P. Harrison, F. H. Atkinson and R. J. C. Dobson

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THE INTERNATIONAL CONFERENCE ON MARINE POLLUTION, 1973, AND RESULTING INTERNATIONAL CONVENTION

R. P. HARRISON, F. H. ATKINSON and R. J. C. DOBSON

INTRODUCTION

The above Conference, which was held under the auspices of the Inter-governmental Maritime Consultative Organisation (IMCO), October/November 1973, has received wide coverage by the news media and technical press. The Conference resulted from two years intensive work by the technical and legal committees within IMCO and numerous abbreviated versions of regulations associated with the resulting Convention have also been published.

In this Paper some amplification of the background to the Conference and its management is given and more important the nature and content of the resulting Convention is reviewed, along with the significant implications for the Society and its Surveyors.

It is intended to first introduce, in general terms, the Conference and Convention, and follow, in more detail, with particular technical aspects associated with the Convention itself.

Representatives from seventy-eight countries together with observers from the United Nations, Inter-Governmental and Non-Governmental International Organisations attended the Conference. A total of some 667 technical and legal experts, together with diplomatic representatives, participated. The organisation required to manage an event of such magnitude, must be self-evident. Four main committees, in addition to the Credentials, Drafting and Steering Committees, were established. Teams of interpreters dealing with four languages were provided for all the plenary and main committee meetings, and over 600 documents, in two languages (English and French), were issued. The burden of this undertaking fell heavily upon the members of the IMCO Staff.

The Society correctly anticipated that the outcome of the Conference would have an important bearing upon its work. The commitment to the Conference, in varying degrees, of six members of the Technical Staff has, by the ultimate terms of the Convention, been justified. These terms permit delegation, by national authorities to classification societies, of responsibilites for survey and certification. Delegation of this nature can be expected to involve several departments at Headquarters as well as many colleagues in the field.

On the various circumstances leading to the Conference, it may be sufficient to briefly refer to the numerous and various pressures for ecological and environmental protection exerted during the last decade or so, which naturally, were influenced by the '*Torrey Canyon*' disaster in 1967. The previous Convention was the 'International Convention for the Prevention of Pollution of the Sea by Oil, 1954,' which entered into force in May 1958, and was subsequently amended in 1962. The 1962 Amendments, in turn, entered into force in May and June 1967. As the title indicated that Convention was limited to pollution of the sea by oil, whereas, the new Convention is much wider in scope, and embraces pollution not only by oil but also by chemicals, sewage and garbage.

Further Amendments to the 1954 Convention were accepted by the IMCO Assembly in 1969 and 1971, but due mainly to time-consuming amendment procedures incorporated in the original Convention, they are *not yet* in force. This delay conflicts with a Resolution adopted in 1962 when amending the 1954 Convention, which referred to the 'Complete avoidance *as soon as practicable* of discharge of persistent oils into the sea.'

It was these prolonged delays in bringing into force amendments to the 1954 Convention, coupled with several other environmental recommendations emanating from the United Nations General Assembly, the United Nations Conference on Human Environment (held Stockholm June 1972), the creation of the United Nations Environmental programme and the important IMCO Assembly Resolutions A.176 (VI) 1969 and A.237 (VII) 1971, which led to the convening of the 1973 Conference and to the form of the new Convention.

Resolution A.176 contained the actual decision to convene in 1973, an International Conference on Marine Pollution for the purpose of preparing a suitable international agreement for placing restraints on the contamination of the sea, land and air by ships, vessels and other equipment operating in the marine environment. Resolution A.237, as well as urging governments to implement the provisions of the 1969 amendments, decided that the planned International Conference on Marine Pollution 1973 should have as its main objectives '*The achievement, by 1975 if possible but certainly by the end of the decade, the complete elimination of the wilful and intentional pollution of the seas by oil and noxious substances other than oil, and the minimisation of accidental spills.*' A further decision was incorporated in Resolution A.237, to the effect, that the Maritime Safety Committee of IMCO should direct its appropriate sub-committee to give first priority to the problem of achieving these goals.

There is little doubt that the Convention, despite it being overshadowed to some extent by the 'Law of the Sea Conference' to be held late 1974 will, upon its entry into force, permit much tighter control of the amount of oil and other noxious substances discharged into the seas.

The ultimate results of the 1973 Conference were:—

'The International Convention for the Prevention of Pollution from Ships, 1973, with its protocols, annexes and appendices'

'The Protocol relating to the Intervention on the High Seas in cases of casualties involving Marine Pollution by substances other than oil'

'A list of some twenty-five Resolutions dealing with various aspects of Marine Pollution or the avoidance of Marine Pollution'

The text of the Final Act of the Conference including its attachments, is deposited with the Secretary-General of IMCO, together with the Convention Document. In addition to the normal IMCO languages (English, French, Spanish and Russian), official translations are to be prepared in Arabic, German, Italian and Japanese. The originals of these translations will be deposited with the Final Act.

The Convention remains open for signature from the 15th January to 31st December, 1974 and thereafter for accession. It will enter into force twelve months after the date on which not less than fifteen States, the combined merchant fleets of which

constitute not less than 50 per cent of the gross tonnage of the world's merchant shipping, have become Parties to it.

The Convention consists of the Articles, which are, the international agreements, and five Annexes containing technical regulations for the prevention of pollution from the sources indicated, as follows:—

Annex I	Oil
Annex II	Noxious Liquid Substances in Bulk.
Annex III	Harmful Substances carried by Sea in Packaged Forms or Freight Containers, Portable Tanks or Road & Rail Tank Waggons.
Annex IV	Sewage from Ships.
Annex V	Garbage from Ships.

It should be noted that Annexes III, IV and V are 'optional Annexes', that is, at the time of signing, ratifying or accepting the Convention, a State may declare, that it does not accept any one or all of these three Annexes. Subject to this provision, parties to the Convention shall be bound by any Annex in its entirety.

The Convention, upon its entry into force, will supersede the International Convention for the Prevention of the Pollution of the Sea by Oil, 1954 as amended. It could hold considerable significance for the Society, since, as previously intimated, National Authorities are permitted to entrust surveys either to surveyors nominated for the purpose, or, to organisations recognised by it. This delegation extends through the various Annexes and could involve not only the Marine and Ocean Engineering Departments of this Society, for ships and floating platforms etc., but also Industrial Services in so far as, fixed platforms, reception facilities, freight containers, portable tanks and rail tank waggons etc. are concerned. The Electrical Engineering Department could be involved with various monitoring and control devices mentioned in the Convention.

Prior to passing on to the Articles and Annexes of the Convention, three items of interest can be mentioned.

First, the possible date for entry into force of the Convention. Unless the present energy crisis dominates world opinion on environmental protection, the Convention might become effective about 1976.

Secondly, the steps taken at the Conference to establish, within IMCO, an organ equivalent to the Maritime Safety Committee (MSC). A Committee, approved by the IMCO Assembly in November, 1973, is named the "Marine Environment Protection Committee" (MEPC). The new committee, like the MSC, is empowered to create whatever sub-committees are required to serve its purpose. The MEPC will execute and coordinate all the work of IMCO in relation to the prevention and control of marine pollution. The formation and workings of this important committee will, no doubt, be closely watched by many States and organisations.

The third item concerns certain amendment procedures incorporated in the new 1973 Convention. In so far as these apply to the Articles they are not so different from those in the 1954 Convention, however, they do differ considerably for any amendment to the Annexes. Here, a form of 'tacit' agreement can be sufficient for adoption of amendments. In other words, rather than wait for a considerable number of the Parties to ratify and adopt an amendment, it can be incorporated, unless a specifically defined proportion of the Parties to the Convention object. It is believed that this procedure will enable many necessary amendments to be brought quickly and effectively into force.

The Articles and Technical Annexes can now be dealt with in more detail.

THE ARTICLES

The rules, conditions etc. defined in the Articles to the Convention comprise the legal elements which form the basis for international acceptance between the contracting States.

The Conference declaration appertaining to the Articles illustrates most clearly the reasons underlying their acceptance and is therefore quoted, as follows:—

'BEING CONSCIOUS of the need to preserve the human environment in general and the marine environment in particular,

RECOGNISING that deliberate, negligent or accidental release of oil and other harmful substances from ships constitutes a serious source of pollution,

RECOGNISING ALSO the importance of the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as being the first multilateral instrument to be included with the prime objective of protecting the environment, and appreciating the significant contribution which that Convention has made in preserving the seas and coastal environment from pollution,

DESIRING to achieve the complete elimination of intentional pollution of the marine environment by oil and other harmful substances and the minimisation of accidental discharge of such substances.

CONSIDERING that this object may best be achieved by establishing rules not limited to oil pollution having a universal purport,

HAVE AGREED as follows:'

The twenty Articles of the Convention then follow.

The various rules and conditions specified in the Articles are not generally of concern to the Society. A few Articles do, however, cover aspects of some interest. It is therefore intended that the subject of each Article shall be given, with further enlargement where considered necessary, as under:—

Article 1 General Obligations under the Convention.

Article 2 Definitions.
This Article includes such items as 'Harmful substance', 'Discharge', 'Ship', 'Administration', 'Incident' etc. 'Ship' means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air cushion vehicles, submersibles, floating craft and *fixed or floating platforms*.

Article 3 Application.

Article 4 Violation.

Article 5 Certificates and Special Rules on Inspection of Ships.
This Article holds a specific interest for the Society since it deals with, in some detail the scope and intervals of surveys and certification.

Article 6 Detection of Violations and Enforcement of the Convention.

Article 7 Undue Delay to Ships.

Article 8 Reports on Incidents Involving Harmful Substances.

Article 9 Other Treaties and Interpretations.
It is specified in this Article that the Convention will supersede the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended, as between Parties to that Convention.

It is further specified that the Convention shall not prejudice the codification and development of the law of the sea by the United Nations Conference on the Law of the Sea convened pursuant to Resolution 2750 C (XXV) nor the present or future claims and legal views of any State concerning such law and the nature and extent of coastal and flag State jurisdiction. (The Conference on the Law of the Sea will convene in August 1974).

Article 10 Settlement of Disputes.

Article 11 Communication of Information.
It is required under the terms of this Article that Parties to the Convention shall communicate to IMCO, in addition to details of laws, orders, decrees etc. promulgated, a list of non-governmental agencies which are authorised to act on their behalf in matters relating to the design, construction and equipment of ships carrying harmful substances in accordance with the provisions of the Regulations. (Classification Societies can be included amongst such agencies).

Article 12 Casualties to Ships.
Each Administration, under this Article, undertakes to conduct an investigation into any casualty occuring to any of its ships subject to the provisions of the Regulations if such casualty has produced a major deleterious effect upon the marine environment. Each Party to the Convention undertakes to supply IMCO with information concerning the findings of such investigations when it judges that such information may assist in determining what changes in the Convention might be desirable.
(The Society could be involved in cases where it has been concerned with the design, construction or inspection of such ships).

Article 13 Signature, Ratification, Acceptance, Approval and Accession.

Article 14 Optional Annexes.
The essential implications of this Article have, already, been mentioned in the introduction to the Paper, namely that a State may at the time of signing, ratifying, accepting, approving or acceding to the Convention declare that it does not accept any one or all of Annexes III, IV and V. Subject to this provision, Parties to the Convention shall be bound by any Annex in its entirety.

Article 15 Entry into Force.
The matter of entry into force of the Convention has been dealt with in the introduction to the paper. The Article does, however, indicate the the position of States which deposit instruments of acceptance etc. after the requirements for entry into force of the Convention or any Optional Annex have been met but prior to the date when such takes effect, and after that date etc.

Article 16 Amendments.
This is rather a lengthy Article which must be studied in detail from the Convention document. It will be found self-explanatory but attention should be paid to the accelerated amendment procedures permitted, in respect of the Annexes, by a form of 'Tacit' agreement.
The Article also contains details concerning amendments to the Protocols and refers to the adoption of new Annexes.

Article 17 Promotion of Technical Co-operation.

Article 18 Denunciation.

Article 19 Deposit and Registration.

Article 20 Languages.
The languages involved are as previously indicated.

Having reviewed those sections of the Articles which may involve the Society, the Technical Annexes may now be examined.

ANNEX I

Regulations for the Prevention of Pollution by Oil

As far as the Society is concerned, perhaps the most important aspect of the 1973 International Convention for the Prevention of Pollution from Ships is Annex I which concerns Regulations for the Prevention of Pollution by Oil. Whilst this Annex refers primarily to oil tankers, it also covers any form of oil pollution whether it comes from dry cargo ships, passenger ships, hydrofoils or drilling rigs.

Annex I is extremely comprehensive and no attempt will be made to interpret each of the 25 Regulations. Reference is however, made to the more important aspects of the Annex and where necessary details are given in tabular form.

The Annex is divided into three main chapters concerned with:—

I General—giving definitions, dates, special areas, applications, surveys, etc., (Regulations 1 to 8).

II Requirements for the Control of Operational Pollution (Regulations 9 to 21).

III Requirements for Minimizing Oil Pollution from Oil Tankers Due to Side and Bottom Damage (Regulations 22 to 25).

Chapter I

Regulation 1 gives definition to a number of terms that are used in the Annex, most of which are readily understood but two are worthy of particular note:—

Oil. Oil means petroleum in any form including crude oil, fuel oil, sludge, refined products etc. Should the oil also be a petrochemical then the more onerous requirements of Annex II must also apply.

New Ship. New ship means a ship:—

(a) for which the building contract is placed after 31 December 1975; or

(b) in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction after 30 June 1976; or

(c) the delivery of which is after 31 December 1979; or

(d) which has undergone a major conversion:

(i) for which the contract is placed after 31 December 1975; or

(ii) in the absence of a contract, the construction work of which is begun after 30 June 1976; or

(iii) which is completed after 31 December 1979.

It is interesting to note that by introducing the above definitions certain aspects of the Convention may well be retrospective if the Convention is not ratified until say, 1st January 1976.

Regulations 4, 5, 6, 7 and 8 concern the certification necessary for all ships under this part of the Convention. An International Oil Pollution Prevention Certificate (1973) shall be issued to:—

1. (a) any oil tanker $\geqslant$ 150 tons gross. } engaged on international voyages
   (b) any other ship $\geqslant$ 400 tons gross. } engaged on international voyages
2. (a) to a new ship on completion.
   (b) to an existing ship 12 months after date of entry into force of present Convention.

The Convention requires tanker to be surveyed during construction and then every $2\frac{1}{2}$ years after this. The surveys at 5 yearly intervals are more onerous than before and concern

equipment
structure
materials
pumping and piping
oil discharge monitoring
oily water separators
tank sizes
stability.

Each of these technical items is a requirement of the regulations found in Chapters II and III and considered necessary to control or reduce operational and accidental pollution. (*See* Table 1).

The validity of a Certificate may, however, be extended by an Administration for a period of up to 5 months to enable a ship to return to the country of registration or to proceed to the port where it is to be surveyed, and only when it appears proper and reasonable so to do. The ship may not then leave country or port without having received a new Certificate.

The Administration may otherwise extend the validity of a Certificate by a period not exceeding one month.

Chapter II

Chapter II of Annex I is concerned with requirements for the control of operational pollution but before examining this Chapter it should be remembered that the foundation of the Convention is to prevent oil and water mixing. For new ships of 70000 tons dwt. and above this will be achieved by having segregated ballast tanks but unfortunately this is not economically feasible on existing tonnage. Therefore three systems to prevent operational pollution are considered:—

1. Control of Discharge of Oil (Load on Top)
2. Shore based reception facilities.
3. Segregated Ballast.

Control of Discharge of Oil

This system, the operational parameters of which are found in Regulation 9, must be practised by all existing ships and new ships of less than 70 000 tons dwt. The requirements represent an improved load on top system with the following operational controls:

(i) the tanker is not within a special area;
(ii) the tanker is more than 50 nautical miles from the nearest land;
(iii) the tanker is proceeding *en route*;
(iv) the instantaneous rate of discharge of oil content does not exceed 60 litres per nautical mile;

TABLE 1

	Type of Surveys	Scope of Surveys
Oil Tankers $\geqslant$ 150 tons gross Other ships $\geqslant$ 400 tons gross	Initial Survey to be held before a ship is put into service, or before the Certificate required by Regulation 5 is issued for the first time.	Structure, equipment, fittings arrangements and materials, for compliance with applicable requirements of Annex I.
	Intermediate Surveys at intervals specified by Administration but not exceeding 30 months. (Certificate to be endorsed).	Equipment, associated pumps and piping systems, including oil discharge and monitoring systems, oily water separating equipment, oil filtering systems.
	Periodical Surveys at intervals specified by Administrations, but not exceeding 5 years.	Structure, fittings, equipment, arrangements and materials.
	Extension of Certificate permitted under Regulation 8(3) or (4) (similar to SOLAS 1960).	(Comment: An intermediate survey will probably be required for such purpose).
Any other ship	Administrations to establish adequate measures to ensure that Regulations are complied with.	

(v) the total quantity of oil discharged into the sea does not exceed for existing tankers 1/15 000 of the total quantity of the particular cargo, and for new tankers 1/30 000 of the total quantity of the particular cargo and

(vi) the tanker has in operation, an oil discharge monitoring and control system and a slop tank arrangement.

Ships operating under this system must comply with the technical requirements of Regulation 15 which requires that existing oil tankers must have slop tanks equivalent to 3 per cent of the oil carrying capacity. On new ships at least two slop tanks must be provided. A complete discharge monitoring and control system must also be provided with a data logging system so that any infringement of the discharge criteria is recorded and subsequently detected. This will require the provision of an oil content meter on the outboard side of the ballast pump as well as an oil interface detector inside the slop tanks.

Similar but not quite so onerous requirements exist for deep tanks, oil fuel bunker tanks and bilges. Every ship over 400 tons gross must have oily water separating equipment. On ships of over 10 000 tons gross a discharge monitoring and control system must also be fitted although equivalents to this are permitted. Every oil tanker is to carry an Oil Record Book in which every cargo or ballast handling operation, including opening or closing valves, is logged.

Reception Facilities

The provision of shore-based ballast-receiving reception facilities as a means of preventing pollution is not of direct concern to the marine side of the Society but may well be of particular interest to Industrial Services. The Convention takes note of special areas where the load on top system would not be acceptable and where the cleaning of any tanks at sea is prohibited. It is incumbent upon member states surrounding these special areas to provide shore facilities to receive dirty ballast, slop tank washings, etc. These are to be provided at the loading terminal, and the special areas, as defined in Regulation 10, are:

(a) Mediterranean Sea

(b) Baltic Sea

(c) Black Sea

(d) Red Sea

(e) Persian/Arabian Gulf.

This total prohibition of discharge is slightly relaxed for ships of less than 400 gross tons but it will be necessary for larger ships sailing in these areas to discharge all ballast to the shore reception facilities for subsequent processing. The technical requirements for the reception facilities are found in Regulation 12. It is the Authors' opinion that the provision of reception facilities has transferred the problem of oil separation from the ship to the shore and that greater pollution nearer to the coast may well result. The Convention requires that reception facilities be available before the 1st of January 1977 and that prior to that date the improved load on top system is to be practised.

Segregated Ballast

Perhaps the most contentious requirement of the Convention, and that which received most interest prior to the Conference, was the mandatory requirement for Segregated Ballast. Research into the design and operational difficulties as well as the advantages and disadvantages of this system received a considerable amount of attention and after a great deal of discussion it was finally agreed (see Regulation 13) that every new oil tanker of over 70 000 tons dwt. shall be provided with segregated ballast anks such that the following draught limitations are complied with in any ballast condition, including the condition of lightweight plus segregated ballast only:—

(a) the moulded draught amidships (dm) in metres (without taking into account any ship's deformation) shall not be less than:—

$$dm = 2,0 + 0,02\ L,$$

(b) the draughts at the forward and after perpendiculars shall correspond to those determined by the draught amidships (dm), as specified in (a) above, in association with the trim by the stern of not greater than 0,015L, and,

(c) in any case the draught at the after perpendicular shall not be less than that which is necessary to obtain full immersion of the propeller(s).

Ballast in excess of the provided segregated ballast tanks may only be taken on if the weather conditions, in the opinion of the Master, are so severe that it would endanger the safety of the ship not to increase the ballast displacement. When this happens a suitable record must be made in the Oil Record Book which is available at all times to National Authorities for inspection. Any frequent departure outside of this requirement would give the Authorities the right to have the segregated ballast capacity of the ship increased further.

Depending on the shape and form of the ship the above criteria means that about 30 per cent of the cargo deadweight must be ascribed to segregated ballast.

With regard to the draught and trim limitations Table 2 indicates what will occur.

TABLE 2

Ship's Length (m)	*Mean Draught* (m)	*Draught Forward* (m)	*Proportion of Length*
150	5	3,88	0,026L
200	6	4,50	0,022L
250	7	5,12	0,020L
300	8	5,75	0,019L
400	10	7,00	0,017L
500	12	8,25	0,016L

Although prior to the Conference considerable discussion took place as to whether segregated ballast double bottom tanks should be mandatory in the end no limitation was placed on the position of the ballast, thus giving more flexibility to the designer. The requirements of this Annex, however, will most certainly mean that new tankers of over 70 000 tons dwt. will operate with considerably less ballast than existing ships of the same size.

It is also worth noting that the concept of separating oil and water has been carried into dry cargo ships and on all new ships of 4000 gross tons and above no water ballast can be carried in oil fuel tanks.

Although the requirements for the ships' hull have been dealt with in some detail there are equally demanding requirements for the pumping and piping arrangements of ships operating under the segregated ballast system.

Chapter III

Damage/Oil Outflow, Tank Size/Stability

Chapter III of the Convention, which comprises of Regulation 22 onwards, is concerned with the requirements for minimising oil pollution from oil tankers due to side and bottom damage and as such is more concerned with accidental pollution rather than operational. The damage criteria have been well-known for some time, previously being part of the 1971 amendments to

the 1954 Oil Pollution Convention, and were changed very little during the final stages of the discussions to the 1973 Convention, except that the size of the bottom damage forward was reduced quite considerably and is now consistent with the stability requirements. Accidental pollution can be controlled very broadly in three ways:—

(a) Oil outflow limitations,
(b) Tank size limitations,
(c) Stability requirements.

To control oil outflow certain sizes of damage envelope are envisaged i.e.

Side damage

(i) Longitudinal extent (l_c): $\frac{1}{3}\left(L^{\frac{2}{3}}\right)$ or 14,5 metres, whichever is less

(ii) Transverse extent (t_c): (inboard from the ship's side at right angles to the centreline at the level corresponding to the assigned summer freeboard) $\frac{B}{5}$ or 11,5 metres whichever is less

(iii) Vertical extent (v_c): from the base line upwards without limit.

Bottom damage

	For 0,3L from the forward perpendicular of ship	Any other part of ship
(i) Longitudinal extent (l_s)	$\frac{L}{10}$	$\frac{L}{10}$ or 5 metres whichever is less
(ii) Transverse extent (t_s)	$\frac{B}{6}$ or 10 metres, whichever is less but not less than 5 metres	5 metres
(iii) Vertical extent from the base line (v_s):	$\frac{B}{15}$ or 6 metres, whichever is less.	

Having arrived at the size of the envelope, every possible combination of tanks, covered by any one damage, is examined to ensure that the oil outflow does not exceed 30 000 cubic metres or 400 $\sqrt[3]{\text{dwt.}}$ whichever is the greater subject to a maximum of 40 000 cubic metres.

For side damage the oil outflow from any combination of tanks is the sum of the volumes of the wing tanks plus, if applicable, the sum of the volumes of the centre cargo tanks effected by the damage corrected by a probability factor depending on the width of the wing tanks. For bottom damage, oil outflow is assumed to be one third of the total volume of the cargo tanks affected—again a probability correction may be made if a double bottom is fitted depending on the height of the double bottom. The outflow formula also takes into account the piping, valve and cargo transfer arrangements as well as the depth of drain wells if double bottom tanks are fitted.

Tank Size

Notwithstanding anything which is controlled by the oil outflow criteria the maximum size of both the centre and wing tanks is limited i.e., centre tanks 50 000 cubic metres, wing tanks—75 per cent of the permitted oil outflow unless the tank is situated between two segregated ballast tanks when 100 per cent is permitted.

Control is also exercised over the tank length depending on the number of longitudinal bulkheads fitted.

Every new oil tanker shall comply with the limitation of size and arrangement of cargo tanks. Every existing oil tanker shall be similarly expected to comply if it falls into either of the following two categories:—

(a) a tanker, the delivery of which is after 1 January 1977; or

(b) a tanker to which both the following conditions apply:

(i) delivery is not later than 1 January 1977 and

(ii) the building contract is placed after 1 January 1974, or in cases where no building contract has previously been placed, the keel is laid or the tanker is at a similar stage of construction after 30 June 1974.

Stability

For compliance with the stability requirements, which applies to all new tankers, the same damage envelope is again assumed but the probability of it occurring at the junction of two wing tanks or a wing tank to engine room bulkhead, varies depending on the length of the ship. (*See* Table 3).

TABLE 3

Regulation 25	Subdivision and Stability
Length of ship	Location of damage
> 225 m	Anywhere in the ship's length
⩽ 225 m but > 150 m	As for ships of L > 225 m, but excluding damage to either forward or after bulkhead of machinery spaces located aft. Machinery compartment thus treated as a single floodable space
⩽ 150 m but > 100 m	Machinery space not treated as a floodable compartment. Damage otherwise anywhere in ship's length but not affecting transverse bulkheads with spacing at least equal to damage length
⩽ 100 m	As for ships of L ⩽ 150 m, but relaxation may be allowed by Administration if fulfilment would seriously impair the operational qualities of ship

After considering heel and trim, the position of the final water line must be such that no progressive flooding may take place. Maximum angles of heel and minimum margins of stability are quoted. When examining stability, consideration is given to the spacing of bulkheads, stepped or recessed bulkheads, piping arrangements, as well as the permeability of the damaged space.

There are three appendices attached to Annex I which cover:—

Appendix I List of oils.

Appendix II Form of certificate.

The certificate covers:—

(a) all ships of over 400 tons gross;

(b) oil tankers or any ships carrying oil in bulk with an aggregate capacity greater than 200 cubic metres.

Appendix III Form of Oil Record Book.

An entry is made in this book every time cargo or ballast is handled. The operation being described in some detail.

ANNEX II

The requirements of Annex II deal with 'the Control of Pollution by Noxious Liquid Substances in Bulk' and the following overall general impressions will, it is hoped, illustrate the importance of the Society's involvement with the subject at this Conference.

To repeat, the principal objectives of the Conference were 'The Complete Elimination of the Wilful and Intentional Pollution of the Seas *and* Minimisation of Accidental Spills.'

Those who have not been connected with the work of the Sub-Committee for Design and Equipment of the Maritime Safety Committee of IMCO may be excused for imagining that the Conference tried to legalise the work of that Committee by a Convention i.e. tried simply to legalise the IMCO Code for carrying dangerous chemicals in bulk. Nothing can be further from the truth.

While Annex II addresses itself specifically to the first objective i.e., the *intentional, controlled* discharge of noxious liquid substances into the sea, the Annex enjoins Governments to achieve the second i.e., the minimisation of *accidental, uncontrolled* discharge into the sea, by issuing detalied requirements for the design, construction, equipment and operation of ships. Such detailed requirements shall at least contain all the provisions given in the code for the Construction and Equipment of ships Carrying Dangerous Chemicals in Bulk adopted by the Assembly of the Organisation as Resolution A.212 (VII). The Annex also states that any amendments to that Code may only be adopted and brought into force in accordance with the provisions of Article 16 dealing with amendments to Appendices to Annexes of the Convention. Clearly, the IMCO code is an internationally acknowledged minimum standard for design and construction but stands outside the Convention as a recommendation.

The concept of controlled and uncontrolled discharges was not arrived at easily. The IMCO Code for chemical carriers was completed in 1970. It groups chemicals in three categories according to their chemical hazard to the environment through toxicity, inflammability, reactivity etc. This brought about design standards for types I, II and III chemical tankers with varying survival capability, separation of cargoes from the sea and from each other. Although not strictly comparable, the Society introduced a similar distinction in its Class notation for Chemical tankers viz, types A, B and C. In 1971 the Sub-Committee for Design and Equipment of the Maritime Safety Committee was requested to consider the pollutant effect of chemicals according to a report by a Joint Group of Experts on the Scientific Aspects of Marine Pollution, the so-called GESAMP report, which categorised chemicals as, (1) highly pollutant (2) medium pollutant and (3) non-pollutant. A study of this Report revealed that a cargo which under the Code could be carried in a type III ship, such as for example bitumen, *could be classed* in the GESAMP report as highly pollutant and therefore should be carried in a type I ship.

For this reason the GESAMP Report was referred back to its Panel of Experts for clarification and background information on how the categorisation was arrived at. During further studies by GESAMP, the Chairman of the D & E Sub-Committee's working group was present. At these meetings it was decided to leave the Chemical Code to stand as an entity and to introduce legislation to avoid the *intentional* spillage of Chemicals causing pollution. Moreover a so-called hazard profile was developed for chemicals which could serve as a 'coarse mesh,' to grade noxious liquid substances into 3 categories.

The GESAMP hazard profile evaluation is based on four types of hazard, those to living resources, to human health, to destruction of amenities and, lastly, the hazard of tainting products. Each type of hazard is sub-divided in degrees of severity. By setting out the type of hazard into four columns and by introducing the degrees on horizontal lines a table can be prepared which makes it possible to arrive at the first rough categorisation of noxious substances. For example, a substance which presents either a very high degree of hazard to living resources or a very high degree of hazard to human life by itself, would obviously fall into the Category A. However a substance could still be regarded as Category A if both these hazards should exist but to a lesser extent or if a lower degree of one should exist with a high degree of hazard to amenities.

In addition the panel used its experience and knowledge of these substances, which could not be clearly specified in numbers, such as the effect of their release in river estuaries or deep oceans and the influence of climatic conditions etc., in order to finally group all substances known to have been transported in bulk into Categories A, B, C and 'other liquid substances' in descending order of hazard. However, under the influence of a delegation which had not been present at the preliminary work in IMCO, a working group was formed during the Conference to study Categorisation yet again. This Working Group split the list of 'other liquid substances' into two parts by extracting and transferring to a new Category 'D' those substances which present a very low degree of hazard to human life or some degree of hazard to amenities or tainting of products, while the list of 'other liquid substances' now contains only substances which are presently considered to present no hazard *nor* harm to human health or marine resources.

The negligible importance attached to the hazards of Category D can be judged from the fact that the Code for the Construction and Equipment of Ships to be developed by the various Governments shall only apply to ships carrying Categories A, B and C. Moreover clauses were introduced in the relevant regulations requiring only limited operational conditions during discharge of Category D substances as opposed to the special measures for those of Categories A, B and C. Virtually the only effect the introduction of Category D has had, is to make it compulsory for ships carrying Category D substances to have a valid certificate on board.

Simultaneously with the work on categorisation, efforts were made to gather information on the amount of any category that could be safely released into the sea. This work was carried out in harmony with attempts to devise and improve drainage systems.

Some full scale experiments were carried out in a Norwegian fjord, recently supplemented by some towing test tank experiments in the United States and Holland.

The present situation appears to be that although the requirements as laid down in Annex II are reasonable and can be achieved, the systems for discharging noxious substances to the sea have not yet been perfected nor standardised. For instance, whether a substance is soluble or insoluble has an important bearing on which system to adopt. It is gratifying to note that the Chamber of Shipping has prepared a document which contains,

in some detail, tentative instructions to Shipping Companies, on how to deal with the various requirements of Annex II, including alternative proposals for drainage systems (Draft revision of Chapter 5 of the ICS Tanker Safety Guide (Chemicals)). Many of these systems will no doubt find their way to the Society's MDAPA Department for comment or approval.

Annex II consists of 13 Regulations and 5 Appendices. It will apply to all ships carrying noxious liquid substances in bulk (chemical tankers), including oil tankers and other vessels when they carry a full or part cargo of noxious liquid substances. Similarly, chemical tankers must comply with the requirements of Annex I if a cargo subject to the provisions of Annex I is carried (Regulation 2).

In Regulation 3 the noxious substances are categorised from A to D. This regulation also provides the procedure to be followed when an application is made to carry in bulk substances which have not yet been categorised or evaluated. It is binding on contracting Governments to notify IMCO of the provisional evaluation of such substances within a stated time, in order that, details of the substances and their provisional categorisation can be promptly circulated to all contracting Governments.

Regulation 4 deals with the 'other liquid substances' stating that they are considered to be harmless but nevertheless requires bilge and ballast water or other residues and mixtures to be discharged as far as practicable from land. Regulation 5 contains the real meat of this Annex viz, the discharge of noxious substances. All the discharge procedures are, however, subject to the provisions in regulation 6, which allows a Master to abandon them in case of emergency in order to safeguard the security of the ship and the safety of the crew.

Basically, Regulation 5 stipulates that the discharge into the sea of Category A substances, their residues or mixtures is prohibited. Governments shall provide reception facilities for tank washings. Only when prescribed, very low, concentrations are reached in the washings, may the residue remaining in the empty tanks be diluted with a stated amount of water and discharged overboard. For Categories B, C and D the discharge rate must be controlled to obtain a specified minimum concentration in the wake of the ship. For Category B this concentration is 1 part per million and for Category D one part of substance to 10 parts of water. Moreover for each of these categories the maximum amount of cargo which may be discharged in this manner is also specified. For all cargoes minimum speeds at which the ship must proceed and minimum distances from land are indicated. From the design aspect the most important provision is that for Categories A, B and C the discharge outlet should be fitted below the water line taking into account the location of the sea water inlets.

Recognition is given to special geographical areas, the present considered areas being the Baltic Sea and the Black Sea, in which Category B and C substances are virtually upgraded to Category A and B. However Special Areas will not be recognised as such until Governments of countries surrounding them have collectively agreed to a date, by which time reception facilities shall be provided by these Governments for the discharge of noxious liquid substances, their residues or mixtures. This proviso was introduced on the insistence of Governments just outside such Special Areas to avoid the possibility of the seas neighbouring their lands becoming the dumping ground for Category B cargoes which ships would not be allowed to discharge and could not discharge, because of lack of shore facilities, within the Special Areas.

A short regulation on shore reception facilities (Reg. 7), incidentally, appears to imply that every port undertaking repairs to chemical tankers will be compelled to have its own reception facilities. This item caused considerable debate at the Conference.

Regulation 8 spells out in some detail the measures of control for implementing the Regulations of this Annex for Categories A, B, C and D in all areas and Category B substances in Special Areas. Not only the discharge from cargo tanks but also those from slop tanks and pump room bilges are subject to these controls. The main instrument of control will be a cargo record book in which entries shall be made of each operation, unloading, discharging, washing etc. Entries will be made by either the Master or a Surveyor appointed or authorised by the Contracting Government, depending on the circumstances under which cargo or slop operations take place.

The United States attempted to make supervision by Surveyors mandatory while the U.K. opposed this move, on the principle of the Master's responsibility and recordings in the cargo book with provision for spot checks. The U.K. considered that insufficient Surveyors would be availble to work the U.S.A. proposal and rejected any suggestion that terminal employees should be authorised to act in this capacity. (The Cargo Record Book is, of course, a legal document admissible in any judicial proceedings as evidence of the facts stated in the entry).

Regulation 10, one of the last, (but from the Society's point of view one of the most important), deals with Survey requirements.

In this Regulation a clause states:—

'The Survey of the ship as regards enforcement of the provisions of this Annex, shall be carried out by officers of the Administration. The Administration may, however, entrust the survey either to Surveyors nominated for the purpose or to organisations recognised by it. In every case the Administration concerned fully guarantees the completeness and efficiency of the survey and inspection.'

Ships are subject to Survey as follows:—

A) Before a ship is put into service as a carrier of noxious liquid substances on voyage to ports or off-shore terminals under the jurisdiction of other parties to the Convention.

B) At intervals specified by the Administration but not exceeding $2\frac{1}{2}$ years, for pumps, piping and equipment.

C) At intervals specified by the Administration but not exceeding 5 years, for the structure, equipment, fittings, arrangements and materials.

The remaining parts of this Annex are devoted to the conditions and procedures for issuing an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk (1973). Again, certificates shall be issued by the Administration or by any persons or organisations (including other contracting Governments) duly authorised by it, the Administration assuming full responsibility for the certificate in every case. Certificates will be valid for a period specified by the Administration but not exceeding five years. Various periods of grace are provided for, to allow for expiry of a certificate at sea, the transfer of the ship to a flag of another contracting government etc.

The Annex concludes with the following Appendices:—

Appendix I	Guidelines for categorisation of noxious liquid substances.
Appendix II	List of noxious liquid substances carried in bulk with their pollution category for operational discharge, their residual concentration by per cent of weight allowed within Special Areas and outside Special Areas and their U.N. number.
Appendix III	List of other liquid substances carried in bulk.

Appendix IV Sample format of cargo record book.

Appendix V Format of 'International Pollution Prevention Certificate for the carriage of Noxious Liquid Substances in Bulk'. The format is given for chemical tankers and ships other than chemical tankers and certificates contain a list of substances for which the ships have been approved as well as a dated and signed drawing of the tank layout, each tank numbered and referenced in list of substances.

ANNEX III

This Annex of the Convention deals with harmful substances carried by sea in packaged form, or in freight containers, portable tanks or road and rail tank waggons and is, as stated before, one of the optional Annexes which a contracting Government may exclude as whole when signing the Convention.

The Annex contains eight regulations which are general in character and deal mainly with the requirement that Parties to the Convention shall cause to be issued detailed requirements on packaging, marking, labelling, documentation, stowage, quantity limitation, exceptions and notification for preventing or minimising pollution of the marine environment by harmful substances.

ANNEX IV

Regulations for the Prevention of Pollution by Sewage from Ships

Annex IV is an optional Annex whose application is dependent on the National Authority and concerns more the operation of the ship rather than its construction. Here again the technical requirements depend on the date of build and a new ship is defined as.—

(a) one for which the building contract is placed, or in the absence of a building contract, the keel of which is laid, or which is at a similar stage of construction on or after the date of entry into force of this Annex, or

(b) the delivery of which is three years or more after the date of entry into force of this Annex.

However all existing ships belonging to National Authorities who have accepted Annex IV must also comply within 10 years of the date upon which this Annex comes into force. It will then be necessary to dispose of sewage by at least one of three methods:—

(a) Sewage treatment plant.

(b) Comminution and disinfecting plant.

(c) Holding tanks.

Every ship is to be fitted with a standard shore connection so that sewage may be discharged ashore. Again certification is necessary with surveys at intervals not exceeding five years.

ANNEX V

Regulations for the Prevention of Pollution by Garbage from Ships

This Annex, like Annex IV, is optional to National Authorities and has no regulations concerning equipment. The Annex is entirely concerned with the operation of the ship detailing where and what sort of, garbage may be disposed of overboard but no certification or survey is necessary.

CONCLUSIONS

It may be reiterated that the 1973 Marine Pollution Conference has, by the production of a Convention, introduced a weapon of considerable magnitude in the struggle to combat and control pollution from ships. The new Convention is the latest in a series of international agreements developed under the auspices of IMCO. These agreements form part of a comprehensive scheme for the international control of pollution originating from vessels and other structures operating in the marine environment.

Amongst these international agreements are included the 1969 Intervention Convention, the 1969 Civil Liability Convention, the 1971 Compensation Fund Convention, and the 1972 Ocean Dumping Convention. In addition, the forthcoming Conference this year on the Law of the Sea will, possibly, introduce a further Convention perhaps having an influence on marine pollution that may arise from exploration and exploitation of the sea bed.

The Convention document has now been published by IMCO and, in turn, copies have been forwarded from Headquarters to the principal offices of the Society throughout the World. An examination of this document, particularly the twenty-six Resolutions associated with the Convention, shows that despite the wide coverage provided by the many technical regulations contained in the various annexes to the Convention, several gaps still exist where much future work is necessary. This work includes such items as the need to develop suitable and efficient oil content monitoring, methods to identify the source of discharge oil, revised methods for the measurement of tonnage associated with segregated ballast tanks, hazard evaluations of noxious substances, the completion of a code for liquefied gas carriers, reception facilities and standards and test methods concerning the discharge of sewage etc. It has been indicated that responsibility for progressing work in this connection should be passed to an 'appropriate body' to be designated by IMCO. This appropriate body is, of course, the newly created Marine Environment Protection Committee (MEPC).

The first task confronting the MEPC is, naturally, the formulation of its own rules of procedure which, when evolved, will be subject to approval by the IMCO Assembly. Subject to the over-riding authority of the Assembly, the MEPC will, in addition to progressing work in the areas indicated, also undertake responsibility for the administration of the various conventions connected with Marine Pollution.

The United Nations Environmental Programme (UNEP) established by the Stockholm Conference on the Human Environment in 1972, although not directly responsible for marine pollution now dealt with by IMCO, takes a keen interest in the subject. It is felt by doing so, UNEP exerts certain pressures which will ensure action by the MEPC, action, which will undoubtedly be beneficial to the health of mankind but perhaps less so to his pocket.

The Authors would particularly invite discussion on this paper from all ports, particularly those abroad, as such a course will provide the opportunity to impart further information on the progress being made by the MEPC and on the effects of the Convention itself. It may be stated that even though the Convention is not yet in force it is having a profound effect on designs now in hand for future ships.

It will be appreciated that when the Convention is fully implemented a vast amount of additional work will devolve upon the Society in respect of surveys and certification for compliance with the terms of the Convention. The purpose of presenting the Paper has, therefore, been to draw to the attention of colleagues the impending implications of such implementation.

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